National Aeronautics and
Space Administration

HOSC-PLAN-623
REVISION B
EFFECTIVE DATE: 8 November 2002

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

FD40

FLIGHT PROJECTS DIRECTORATE
GROUND SYSTEMS DEPARTMENT

HUNTSVILLE OPERATIONS SUPPORT CENTER (HOSC) PROJECT PLAN

HUNTSVILLE OPERATIONS SUPPORT CENTER PROJECT PLAN

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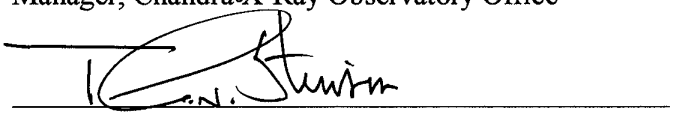

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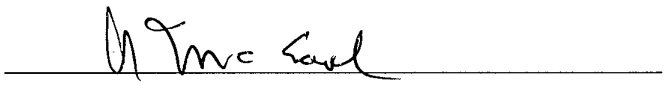

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FOREWORD

This project plan describes the objectives, requirements and planning for the Marshall Space Flight Center (MSFC) Huntsville Operations Support Center (HOSC). The plan has been prepared in accordance with NASA Procedures and Guidelines (NPG) 7120.5A – *NASA Program and Project Management Processes and Requirements*. The plan is consistent with the NASA Strategic Management Handbook and NASA Policy Directive (NPD) 7120.4B – *Program/Project Management*. This plan also provides an overview of the organizational structure, responsibilities, procedures, processes, and resources for implementing ANSI/ASQC Q9001-2000 in accordance with NPD 8730.3, *NASA Quality Management System Policy (ISO 9000)* and MPD 1280.1, *Marshall Management Manual*. In this regard, this plan is intended to present top-level requirements document referencing lower-tier documents with more detailed requirements and instructions.

A Change Log is provided after the FOREWARD to detail any document revisions that have been made to this plan, the date the revisions were made, and a description of the applicable changes. A list of references is provided as Appendix C and an Acronym List is provided as Appendix D.

CHANGE LOG

Status (Baseline/ Revision/ Canceled)	Document Revision	Effective Date	Description
Baseline		10/13/00	
Revision A		9/6/2002	• Removed references to the International Space Station (ISS) sustaining engineering support activity. • Schedule updated (Section 7.0) • Resources updated (Section 8.0) • Transition to CSOC contract support updated (Section 11.0)
Revision B		11/10/2002	• Removed Payload Data Library requirement.

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1.0 INTRODUCTION

This Huntsville Operations Support Center (HOSC) Project Plan defines the project goals and objectives, requirements, organization, management responsibilities, resources, schedules, and controls. These are presented within the context of the International Space Station (ISS) Program, the Space Shuttle Program, Microgravity Research Program, and the Chandra X-Ray Observatory Program, which the HOSC Project supports.

1.1 PURPOSE

The purpose of the HOSC Project is:

- To provide and operate the ISS Payload Operations Center (POIC)/United States Operations Center (USOC)/Payload Data Services System (PDSS)/Payload Planning System (PPS) payload operations facilities and systems for conducting the ISS utilization program,
- To provide sustaining engineering for the Chandra X-Ray Observatory (CXO) Operations Control Center (OCC) located in Cambridge, MA,
- To provide a ground facility to host engineering systems that enable MSFC engineers to support Space Shuttle pre-launch, launch and post-launch operations activities,
- To provide and operate the ground systems for the MSFC Telescience Support Center (TSC), and
- To provide an electronic system for collection, processing, management, and distribution of data to integrate payloads for transportation, installation, and operation on the International Space Station.

1.2 GOALS

The HOSC Project provides multi-program and multi-discipline support by developing and using common hardware, software, facilities, and operations personnel. The supported programs share the costs of common/generic capabilities/features thus reducing the overall costs to NASA. The goals of the HOSC are to:

- Provide core ground system capabilities that will service multiple program/project needs,
- Provide program/project-unique capabilities as needed,
- Provide HOSC systems operations for all hosted projects, and
- Meet or exceed customer expectations for HOSC systems and their operations.

1.3 OVERALL APPROACH

1.3.1 Requirements

The HOSC Project develops capabilities based on the needs of the supported programs. Requirements originate from the project and are combined with overall NASA requirements (standards, directives, etc.) at the early stages of a HOSC-supported program. Through analysis of existing requirements and new program requirements, the initial HOSC implementation requirements are generated and assessed to be either generic or project specific, as depicted in Figure 1.3.1-1. These baseline requirements are further expanded into lower level requirements specifications and detail designs by the HOSC Project implementing contractors and Government teams.

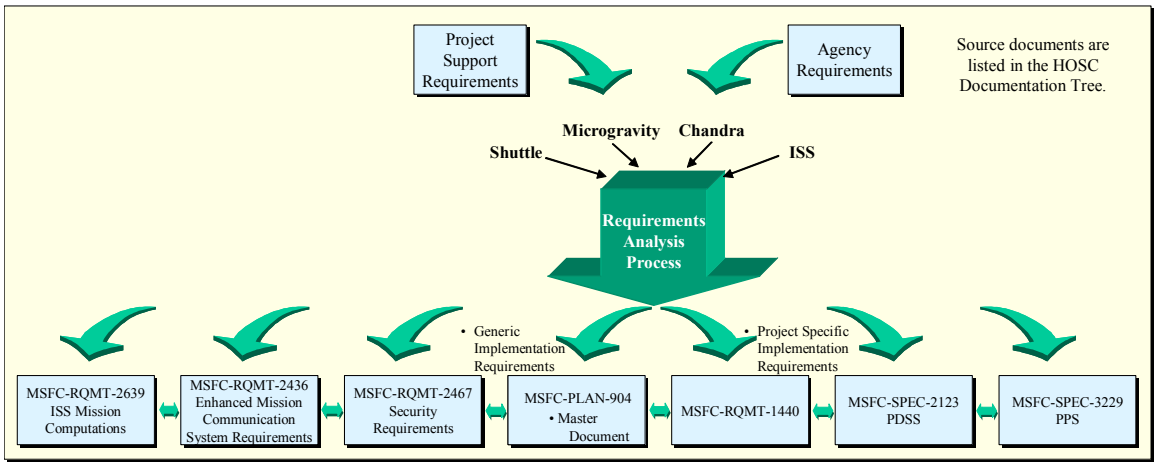

Figure 1.3.1-1. Overall Approach

1.3.2 Technical

The overall technical approach to achieving the HOSC Project goals is first, to establish a generic telemetry and command processing system based on the use of generic telemetry/command database standards. Then, standard telemetry visualization, command generation, and operation capabilities are provided, which allow rapid user development of console products. These generic capabilities are designed to run on a distributed computer/network architecture that allows at least one level of fault tolerance. Standard voice and video systems are provided to enhance communication between ground mission personnel and with on-orbit crew. Program unique systems that provide front-end data capture and distribution, information management, mission planning, command load generation, and attitude determination are developed as required.

These generic and project-unique capabilities are implemented in a building block approach, wherein successive 'builds' or major system deployments add capabilities as are required for the supported Programs. Each contains successive build and/or deployment content, while the bulk of the build has undergone significant testing and mission use. This building block approach provides a steady maturation process for the HOSC systems. Finally, for HOSC-

hosted projects, an Integrated Support Team (IST) operates the HOSC facility and systems for the projects as required.

1.3.3 Management

The overall management approach to achieving the HOSC Project goals is in accordance with the Project Implementation requirements of NPG 7120.5A, as conceptualized in Figure 1.3.3-1.

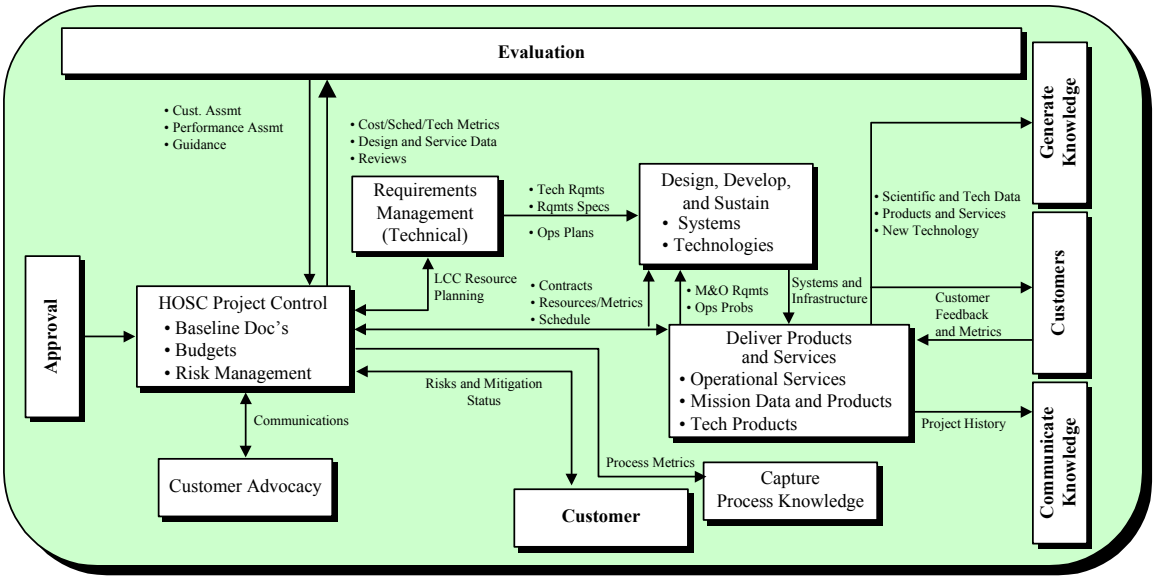

Figure 1.3.3-1. Overall Management Approach

The FD40 Ground Systems Department (GSD) is assigned to manage the HOSC Project by the Flight Projects Directorate. The GSD provides requirements management, generates customer agreements and ensures on-going customer advocacy, and provides direct management interfaces to supported programs. The GSD initiates and manages contracts which provide design, development, and maintenance and operation of HOSC systems.

The principal performance metrics and the principal risks are defined with and routinely reported to the supported programs. The *planned* performance (cost, schedule, and technical) is compared with *actual* performance on a monthly basis. Similarly, project risks and their mitigation plans are identified and reported on a regular basis.

1.4 TIMEFRAME

The HOSC has provided essential and successful facilities, systems and services for numerous NASA Programs since the late 1950s. These include: Army Orbit Determination, Saturn Program, Skylab, Space Transportation System, Spacelab, Tethered Satellite System, Chandra X-Ray Observatory (CXO), the International Space Station (ISS) Program and various Shuttle Payloads. (The Project history is synopsized in Appendix A.)

The HOSC Project has one major development/maintenance activity that is currently ongoing for the ISS program. The HOSC began ISS operations in mid-2000 and will provide round-the-clock support for approximately 15 years. Shuttle support is renewed on a yearly basis based on program need. Development and maintenance of the MSFC Telescience Support Center (TSC) is provided.

2.0 OBJECTIVES

2.1 ISS OBJECTIVES FOR HOSC PROJECT (PPS, PDSS, POIC, AND USOC)

A. Provide 24x7 HOSC Facility support for the life of the ISS.

B. Provide remote services to U.S. and International payload customers.

C. Distribute all ISS payload telemetry and make it available for recall.

D. Provide distributed command and control capabilities necessary to operate onboard payload and core ISS systems.

E. Provide distributed payload planning capabilities for U.S. and International payload customers.

F. Provide HOSC system software to the Kennedy Space Center (KSC).

G. Provide monitor, command and control capabilities to local and remote users via PC- and UNIX-based applications.

H. Provide database application software for integration of payload data.

I. Provide facility space, equipment, and personnel for voice, video, and network support for the ISS Payload Operations including:

Payload Control Area 1 (PCA-1)

Payload Control Area 2 (PCA-2)

Mission Integration and Coordination-1 (MIC-1)

Mission Integration and Coordination-2 (MIC-2)

Short Term Planning 1 (STP-1)

Short Term Planning 2 (STP-2)

Records Management Room

Sim Room

Execution Support Room

PAO & Status Recorder Room

United States Operations Center (USOC).

2.2 ISS PERFORMANCE COMMITMENTS (PPS, PDSS, POIC, AND USOC)

A. Provide critical HOSC services such that interruptions will be less than one hour per event for the life of the program.

B. Provide remote services to NASA TSCs, International Partners (IPs), and ISS Program approved remote U.S. payload operations sites.

C. Distribute 95% of all ISS payload telemetry and make recall of last two years available for life of program.

D. Transmit/transfer greater than 98% of all valid payload/core system uplink commands and files to the Mission Control Center – Houston (MCC-H).

2.3 CXO OBJECTIVES FOR HOSC PROJECT

A. Provide sustaining engineering support for the Operations Control Center.

2.4 CXO PERFORMANCE COMMITMENT

B. Provide services as defined in the Collaborative Work Commitment.

2.5 SHUTTLE PROPULSION SUPPORT OBJECTIVES

A. Provide HOSC Operations Support for Shuttle pre-launch tests and provide 24x7 support for Terminal Countdown Tests, Flight Readiness Firing Tests and Launch.

B. Host Shuttle program-provided engineering systems in the Shuttle Engineering Support Room (SESR).

C. Provide remote voice services to Boeing (Canoga Park, CA), Honeywell (Clearwater, FL), Thiokol (Brigham, UT), Michoud Assembly Facility (Michoud, LA), USA (4202 MSFC and Huntsville, AL), Rocketdyne (4203 MSFC), Hernandez (4471 MSFC), and Pratt & Whitney (West Palm Beach, FL).

D. Maintain Meteorology Interactive Data Display System (MIDDS) for launch support.

2.6 SHUTTLE PERFORMANCE COMMITMENTS

A. Provide defined HOSC services such that interruptions will be less than one hour per launch support event.

B. Provide facility space, equipment, and personnel for voice, video, and network support in these areas:

1. Shuttle Engineering Support Room (SESR)
2. Terrestrial Operations Support (TOPS) Room
3. Conference Work Area (CWA)
4. Shuttle Action Center (SAC).

2.7 MSFC TELESCIENCE SUPPORT CENTER OBJECTIVE

A. Provide 24x7 HOSC support for life of the ISS.

2.8 MSFC TELESCIENCE SUPPORT CENTER COMMITMENTS

A. Provide 95% of MSFC TSC telemetry and make recall of last two years available for the life of the ISS Program.

B. Transmit/transfer greater than 98% of all valid payload/core system uplink commands and files to the POIC.

2.9 QUALITY/BALANCED SCORECARD OBJECTIVES AND GOALS

HOSC Project quality objectives and goals, including support for NASA and MSFC quality objectives and goals flow-down (Balanced Scorecard), are defined in HOSC-PLAN-661, Quality Plan for the HOSC.

3.0 CUSTOMER DEFINITION AND ADVOCACY

The HOSC supported customers and the processes used to ensure customer advocacy are identified in Figure 3.0-1. The frequency of management reviews is established by the customer and is different for each project. Customer surveys are randomly performed with regard to frequency and individual surveys.

Customer Advocacy Method	Program	Customer
Periodic Management Reviews	ISS	ISS Payloads Office
Customer Surveys, HOSC CCB Membership	ISS	Payload Operations Integration Function Cadre
Customer Surveys, HOSC CCB Membership	ISS	NASA Telescience Support Centers (ARC, JSC, MSFC)
Customer Surveys, HOSC CCB Membership	ISS	Payload Checkout and Test (KSC)
Customer Surveys	ISS	U.S. Payload Operations Sites
Customer Surveys	ISS	International Partners
Customer Surveys	ISS	Italian Space Agency
Customer Surveys	ISS	Payload Investigators
Periodic Management Reviews	STS	MSFC Space Shuttle Projects Office
Customer Surveys	STS	Propulsion Elements Engineering Team
Customer Surveys	STS	Terrestrial Operations Support Team
Periodic Management Reviews	Microgravity	MSFC Microgravity Science and Applications Dept.
Customer Surveys	Microgravity	MSFC TSC Payload Developers

Figure 3.0-1. Customers and Advocacy

4.0 PROJECT AUTHORITY

The organization of authority for the ISS Program is shown in Figure 4.0-1.

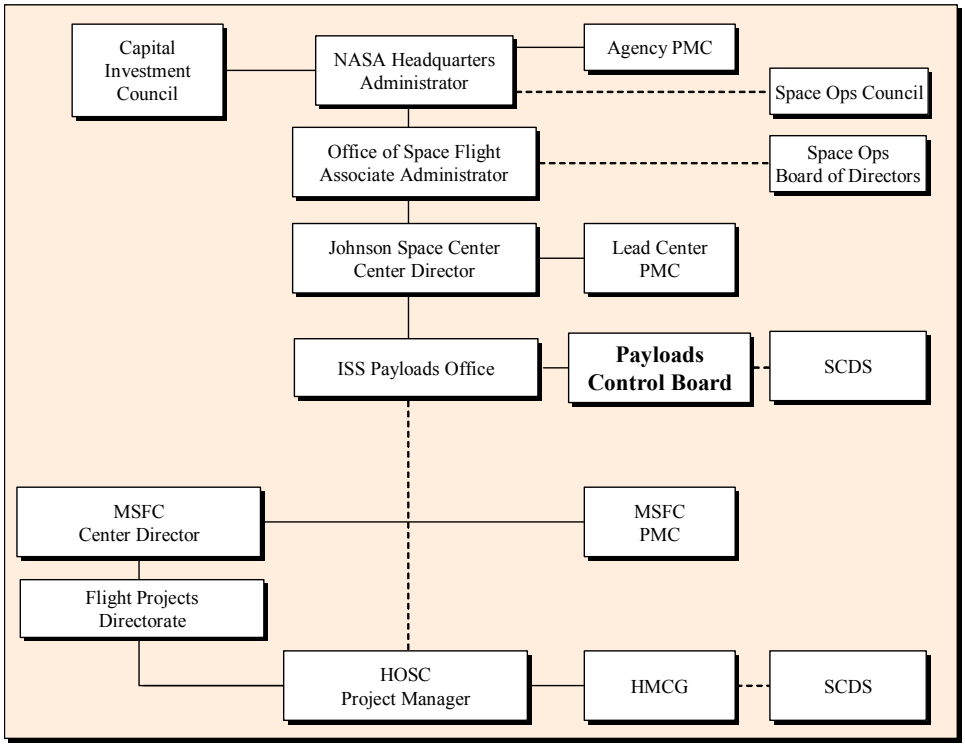

Figure 4.0-1. ISS Program/Project Authority

The organization of authority for the CXO Program is illustrated in Figure 4.0-2.

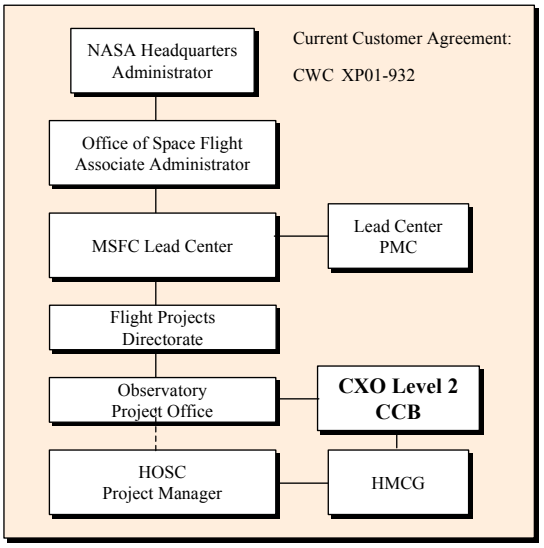

Figure 4.0-2. CXO Program/Project Authority

The organization of authority for the STS Program is illustrated in Figure 4.0-3.

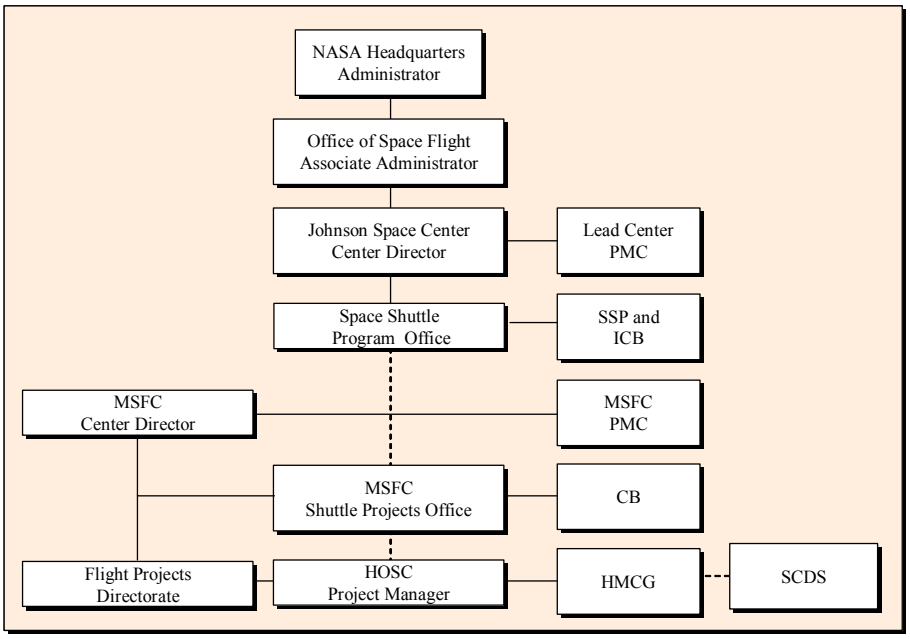

Figure 4.0-3. STS Program/Project Authority

The organization of authority for the MSFC Microgravity Science and Applications Department is illustrated in Figure 4.0-4.

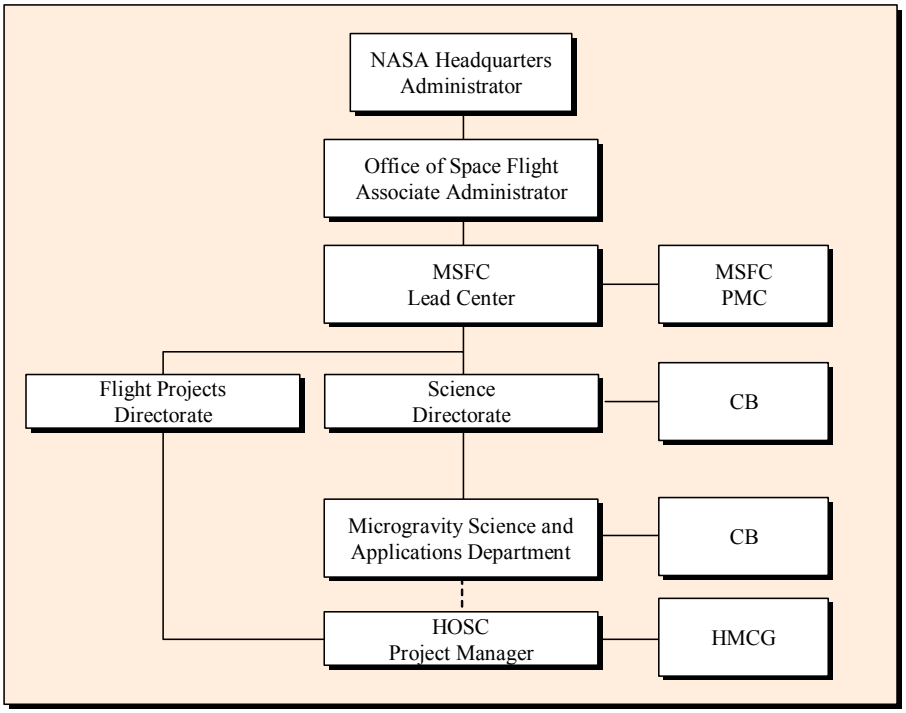

Figure 4.0-4. Microgravity Research Program Authority

5.0 MANAGEMENT STRUCTURE

The following sections describe the Project Management of the HOSC Project.

5.1 ORGANIZATION AND RESPONSIBILITIES

The MSFC Flight Project Directorate's Ground Systems Department (GSD) is responsible for project management of the HOSC Project. Relationships with supported programs are shown in Figures 4.0-1 through 4.0-4. The GSD's organization contains complete, end-to-end mission ground systems design, development and operations engineering expertise. Management of budget and schedule for all GSD projects is the responsibility of the Department Manager (HOSC Project Manager), while technical responsibilities are assigned to the Group Leads and further delegated to the Team Leads. Figure 5.1-1 depicts the Department organization structure.

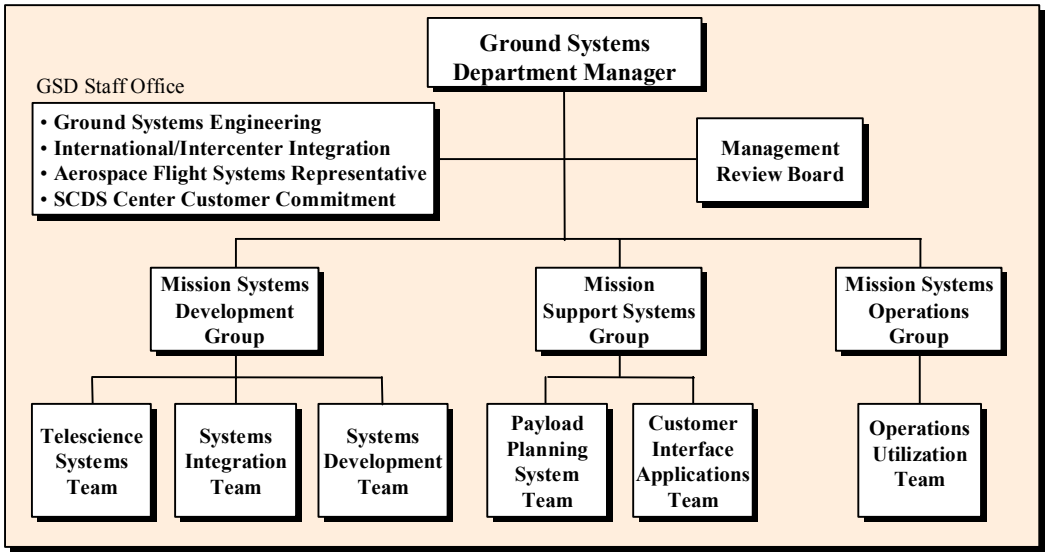

Figure 5.1-1. HOSC Project Management Structure

Overall responsibilities are defined in Appendix B to include Headquarters, Center, and Program levels. The allocation of responsibilities for the HOSC Project technical requirements is defined in Figure 5.1-2.

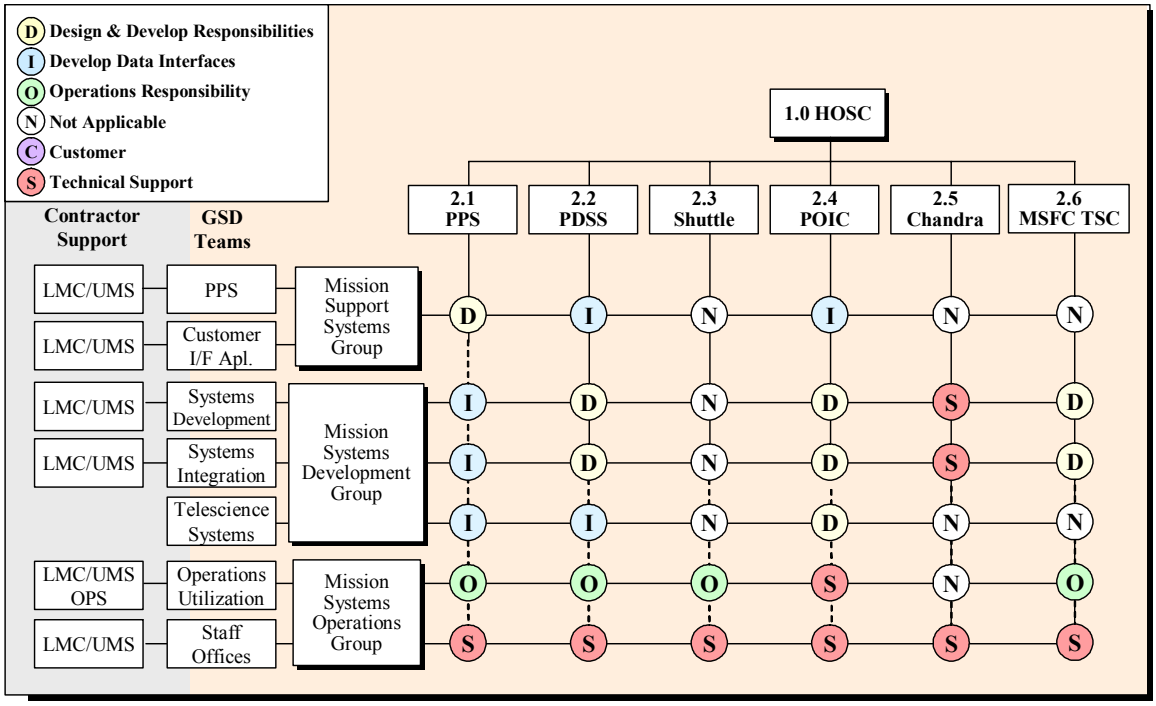

Figure 5.1-2. Requirements/Responsibilities Allocation

5.2 SPECIAL BOARDS AND COMMITTEES

Configuration Management of the HOSC is performed as described in MSFC-PLAN-2929, Configuration Management Plan for the HOSC. This includes a Level III configuration control board (CCB), the HOSC Management Coordination Group (HMCG), and HMCG-authorized Level IV coordination groups, which perform the CCB functions for HOSC subsystems. The relationship of the project documentation to the configuration management structure is described in the HOSC Project Data Management Plan, MSFC-PLAN-3046.

A Management Review Board (MRB) guides implementation of quality-related activities as defined in the HOSC Quality Plan. The MRB also serves as the risk management board, as defined in HOSC-PLAN-635, HOSC Risk Management Plan.

Performance evaluation boards (PEB) are utilized to evaluate the performance of HOSC Project support contracts. These are described in Section 11.

5.3 MANAGEMENT PROCESSES

5.3.1 Resources Management

The following sections outline the specific processes used to perform financial, life cycle cost and information technology management.

5.3.1.1 Financial Management

General

The GSD supports all phases of budget development and administration for the HOSC Project. Reviews of program guidelines are conducted in the development of the yearly Program Operating Plan (POP)-submittals. These POP-submittals are reviewed with appropriate MSFC management and NASA program management. POP-submittals are generated for the following:

A. ISS Payload Operations Integration Center
B. ISS Payload Data Services System
C. ISS Payload Planning System
D. ISS Payload Data Library
E. Chandra Operations Control Center
F. Shuttle Engineering Support Room and MIDDS
G. Telescience Support Center

Contractor Financial Reporting

HOSC Project contractors file monthly Form 553Ms detailing planned expenditures, actual expenditures, and run-out costs.

Reviews

The GSD conducts monthly Business Management Reviews with the contract management teams. These reviews cover year-to-date financial planned/actual expenditures, cost evaluation performance, contract funding status and procurement status.

The GSD provides monthly financial metrics reports to the ISS Payloads Office at the Johnson Space Center. No special reports are given to the CXO Program or the Space Shuttle Projects Office at MSFC, although monthly reports were provided throughout system development.

5.3.1.2 Life Cycle Cost Management and Accounting

Life cycle cost (LCC) is estimated, assessed and controlled on an on-going basis. Program commitment is developed in the Customer Agreement Review Process, discussed in Section 9.1. Reviews are conducted as discussed in Section 5.3.3.2. And, budgetary submissions are supported as also discussed in Section 9.1.

Full cost initiative guidance is used as available.

Cost estimates are summarized according to the HOSC Project WBS, as shown in Section 8.

The Project maintains financial and schedule flexibility to ensure that customer commitments are met.

LCC changes are managed using the CM process of Section 9.2. Engineering Change Requests (ECRs) which are submitted to the HMCG are assessed for technical implementation, cost impacts, and/or schedule impacts. For those changes that have cost impacts, the development cost and the sustaining engineering costs are generated by the development organization (NASA or contractor) and presented to the HMCG board. This total life cycle cost estimate is then assessed for compatibility with the HOSC Project budget. If compatible, the change request is approved and the effected project WBS elements are updated. If incompatible, the change requests are held open if an attempt will be made to acquire the necessary funding. Otherwise, the ECRs are disapproved for lack of funding.

5.3.1.3 Information Technology (IT) Management

NASA-provided IT capabilities and resources fulfill 100% of the IT requirements and resources for the HOSC Project. The HOSC Project funds the procurement of PCs and license fees necessary to connect contractor employees into the existing NASA IT infrastructure.

IT security is managed in compliance with MSFC-RQMT-2467.

5.3.2 Risk Management

HOSC Project risk management is performed according to the HOSC Risk Management Plan.

5.3.3 Performance Management

This section describes the processes used to track and maintain successful performance of the HOSC Project.

5.3.3.1 Earned Value Management (EVM)

EVM is not used on the HOSC Project. The ISS Payloads Office, the CXO Project Office, and the Shuttle Projects Office have waived this requirement for the HOSC Project.

5.3.3.2 Performance Assessment

The HOSC Project performance is measured by a comprehensive set of cost, schedule, technical and risk metrics. Figure 5.3.3.2-1 identifies the specific metrics collected and the frequency of review.

Item	Planned vs. Actual	Review
Cost	FTEs (Monthly + YTD) Labor Hours (Monthly + YTD) Direct Labor ($) (Monthly + YTD) 3559 Material Procurement (Monthly + YTD) Overtime/Shift Premiums (Monthly + YTD) Travel and Training (Monthly + YTD) Relocation (Monthly + YTD) Vehicle (Monthly + YTD) 424 Procurements (Monthly + YTD) Facilities (Monthly + YTD)	Monthly
Schedule	Software Delivery Dates CSCI/CSC Development Metrics Hardware Room Operational Readiness Test Procedures Delivery Dates Operations Procedures Training and Certification Status	 Per Event Bi-Weekly/Build Readiness – 30 Days Per Event Monthly Monthly
Technical	Software Build Requirements Problem Fixes ECRs Hardware Problems Fixes ECRs Test Test Scripts Executed Requirements Tested ECRs Tested Problem Fixes Tested Objectives/Commitments (Ref. Section 2.0) Objectives Commitments Quality/Balanced Scorecard	Per Build Event Per Build Event Per Build Event Per ECR processing and V&V Monthly review of Management Metrics Package Monthly by MRB
Risk	All Identified Risk Items	Monthly by MRB

Figure 5.3.3.2-1. HOSC Project Performance Metrics

5.3.3.3 Schedule Management

HOSC Project schedules are developed and managed in three tiers as illustrated in Figure 5.3.3.3-1. Level II schedules are driven by the individual program requirements.

The HOSC Project defines Level III schedules based on Customer Agreements/Collaborative Work Commitments (CWC) as described in Section 9 – Controls. The GSD staff and contractors derive Level IV schedules from the Level III schedule requirements. Performance against the schedules is managed as discussed in Section 5.3.3.2.

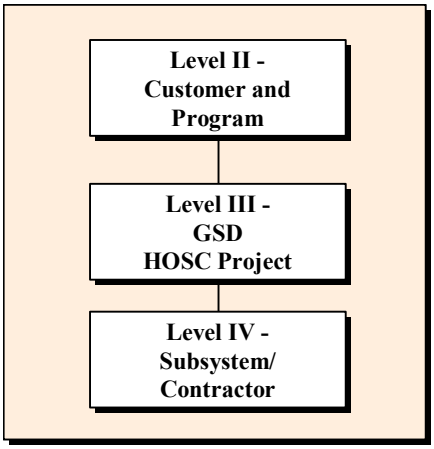

Figure 5.3.3.3-1. Program Schedules

6.0 TECHNICAL SUMMARY

This section provides a brief overview of the HOSC Project systems, facilities, and services and the allocation of the customer requirements to these provided systems, facilities, and services.

6.1 HOSC PROJECT FACILITIES

6.1.1 International Space Station

6.1.1.1 Payload Operations Integration Center

The POIC is required to provide an extensive set of services to support ISS-specific payload operations. The POIC provides telemetry processing of the Payload Health and Status data, the ISS core systems data as well as ground-generated test and simulation telemetry. Uplink command processing services are provided to allow operation of payloads and core systems. The POIC is required to provide for development, storage and delivery of payload operations procedures, and generation of ground ancillary data.

6.1.1.2 United States Operations Center

The USOC facility is in close proximity to the POIC and utilizes the services and interfaces offered by the POIC and the PDSS. It provides payload user workstations, user work areas, and user conference areas to support real-time, training and simulation operations of on-orbit payloads. The USOC is required to provide the capability for the user to interface electronically with other appropriately equipped user operations facilities.

6.1.2 Microgravity Science and Applications Department

6.1.2.1 MSFC Telescience Support Center (TSC)

The MSFC TSC provides the capability to plan and operate on-orbit facility class payloads and experiments, other payloads and experiments, and instruments. The MSFC TSC is to process and analyze engineering data, process science data, and distribute data to its associated local and remote user community. The MSFC TSC resources and capabilities are to include the facility hardware, software, operations, maintenance, engineering, communications, and systems required to support ISS payload operations, control, and planning. The HOSC resources necessary to support the MSFC TSC are submitted by the MSFC TSC manager and agreed to by FPD.

6.1.3 Chandra X-Ray Observatory (CXO) Program

6.1.3.1 CXO Operations Control Center (OCC)

The HOSC provides sustaining engineering support for the Operations Control Center Technical Support Team.

6.1.4 Space Transportation System (STS) Program

6.1.4.1 Shuttle Engineering Support Room (SESR)

The SESR is required to provide technical support during various Shuttle pre-launch and launch activities for all missions. This technical support is associated with MSFC-responsible propulsion elements which include: External Tank (ET), Solid Rocket Boosters (SRB), Reusable Solid Rocket Motor (RSRM), Safety and Mission Assurance (S&MA), Space Shuttle Main Engines (SSME), and Main Propellant System (MPS). The SESR provides voice and network/communication services and it hosts program-provided data systems.

6.1.4.2 Terrestrial Operations Support (TOPS) Room

The Terrestrial Operations Support (TOPS) Room provides support to the JSC Loads and Day of Launch I-loads Update (DOLILU) Officer for each Shuttle countdown. The primary wind monitoring and the approval/assembly of the upper-level wind data package for each Jimsphere balloon release and measurement is performed by the personnel hosted in the TOPS Room. The TOPS Room provides mandatory voice and network/communications and hosts the Meteorological Interactive Data Display System (MIDDS) workstations.

6.2 HOSC PROJECT SYSTEMS AND SERVICES

The HOSC Project consists of a number of system components which, coupled with a highly trained ground systems operations staff, provides the implementation of the HOSC Project customer requirements. The major systems which comprise the HOSC Project are:

- Enhanced HOSC System (EHS)
- Payload Data Services System (PDSS)
- Payload Planning System (PPS)
- STS-provided Systems.

The services provided by these elements are discussed in the following sections.

6.2.1 Enhanced HOSC System

6.2.1.1 Data Acquisition and Distribution Services

The generic Data Acquisition and Distribution Services (DADS) provide a high-speed communications interface to the NASA networks for the interchange of telemetry, commands, and other real-time operations data. Acquired telemetry data has front-end processing performed on it such as determining data quality and then it is put in packets to be routed locally to machines providing other services. This service also receives user-initiated commands and transmits them to destinations external to the EHS.

6.2.1.2 Telemetry Processing Services

The generic Telemetry Processing Services (TPS) receive packetized data, real-time data or playback data, routed from or via the DADS. These packets are logged to a database called the Near Real-time Database that maintains some number of hours of the latest received packets. The packets in this Near Real-time Database are available for generating reports and for playing back the data as it was received. The packets received by the TPS are also available for immediate use. User-requested parameters are extracted from the packets and processed as specified by the user. These parameters are then available for use in visualization, computation, and like activities.

6.2.1.3 User Services

User Services provide a common graphical user interface, telemetry display generation/operation capability and command update form generation and utilization. General-purpose tools consisting of a suite of commercial products provide a word processor, a text editor, a graphics package, electronic mail, and printing capabilities.

6.2.1.4 Command System Services (CSS)

The CSS allows users to view, modify, and initiate the transmission of commands. A log of all command transmissions and their acceptance responses is maintained. The CSS also

provides a scripting capability which allows users to write scripts which can monitor telemetry data and modify and initiate commands when specified conditions are detected. Command System management provides complete control of the individual commands, users, and system uplink operations.

6.2.1.5 Mission Support Services (MSS)

The MSS provides a generic capability for electronic Management Information System functions. Some of the functions include: system assistance, operations forms processing, word processing and documentation development and control. MSS also provides the capability for interfacing with mission-specific functions such as mission planning, procedures development, and engineering analysis/trend analysis.

6.2.1.6 Database Services

Database Services provide a centralized, relational database service for storing user products, telemetry and command definitions. The Database Services provide a means of limiting access to these elements via built-in user authorizations. The Database Services also provide a means for populating and maintaining the telemetry and command databases.

6.2.1.7 Audio Distribution System

Audio services include flexible transmit and receive options for teleconferencing, public address, console operations, and internal HOSC operations. Space flight operations circuits are allocated based on user authorization.

6.2.1.8 Video Distribution System

Video services include configurable receive and transmit options for console operations and for teleconferencing.

6.2.1.9 Integrated System Monitor and Control (ISMAC)

The ISMAC subsystem provides a centralized management and control of hardware and selected software elements within the EHS. It is exclusively used by the O&M support team.

6.2.1.10 Integrated Support Team (IST)

The IST is the ground operations staff trained to operate all HOSC Project systems, perform fault isolation and recovery procedures, and assist users in the use of HOSC systems.

6.2.1.11 Telescience Resource Kit (TReK)

The TReK is a low-cost PC-based system that provides capabilities to generate displays/command forms, generate telemetry/command databases, process telemetry, and uplink commands.

6.2.2 Payload Data Services Systems (PDSS)

The PDSS is required to provide for the receipt, storage, and distribution of all ISS payload science, health and status, flight ancillary data, and ground ancillary data to the POIC, USOC, International Partners, and user operations facilities. This includes support of the ISS return-link, ISS simulation data, and test data. In addition, the PDSS is required to provide receipt and distribution of core systems data to the POIC.

6.2.2.1 Data Distribution Services

These services provide high-speed distribution of real-time data and provide for the retransmission of stored data to the POIC/USOC, external NASA telescience centers and payload sites, and to the ISS International Partners.

6.2.2.2 Data Retrieval and Storage Services

These services provide the capability to store payload and ground ancillary telemetry for up to two years. The capability to retrieve telemetry for retransmission over high-speed networking for file transfers over the Internet, and/or for the distribution of telemetry products on 8-mm tape.

6.2.2.3 Systems Support Services

These services provide the control and monitoring interface to the PDSS. This control and monitoring interface connects to minimum local function and via a network connection to the EHS ISMAC services.

6.2.2.4 Data Acquisition and Extraction (DAE) Services

The DAE services receive Ku-Band and S-Band telemetry from the ISS. The DAE performs a data quality assessment and then extracts the CCSDS packets and BPDUs. These packets and BPDUs are made available for storage and distribution.

6.2.2.5 Test and Simulation (TAS) Services

The TAS services provide simulated downlink Ku-Band and S-Band telemetry, which is used to test PDSS and remote payload customer interfaces, and the capability to ingest actual payload or systems packets and output them in the simulated Ku-Band or S-Band telemetry streams.

6.2.3 Payload Planning System (PPS)

The PPS is an automated software tool used by payload planning personnel to produce increment specific planning and execution support products. These products are required to support payload execution for an increment (pre-increment, weekly, and during increment execution).

6.2.3.1 Product Generation (PG) Services

The PG services provide the user community with the capabilities to display and print payload planning information such as Resource Comparison reports, Data Flow Plan reports, etc.

6.2.3.2 User Requirements Collection (URC) Services

The URC services provide the user community with capabilities to define onboard resource requirements, collect the operations requirements, and to transform these requirements into formats required by other PPS components.

6.2.3.3 Data System Routing and Configuration (DSRC) Services

DSRC services provide capabilities to develop detailed ISS telemetry/voice/video routing schedules, onboard data system telemetry/video recorder operations schedules and Ku-Band downlink configurations.

6.2.3.4 Flight Dynamics Planning and Analysis (FDPA) Services

FDPA services provide the capability to determine orbit opportunity acquisitions and losses based on Space Station attitude, configuration, and position. FDPA software is provided by JSC and the HOSC Project provides interfaces to and hosting services only for FDPA.

6.2.3.5 Consolidated Planning System (CPS)

The CPS is developed by JSC and provides the capabilities to develop the detailed ISS timeline/Short Term Plan (STP) and the Onboard Short Term Plan (OSTP). The HOSC Project provides interfaces to and hosting services only for the CPS.

6.2.3.6 External Data Repository (EDR) Services

EDR database services support the exchange of data between PPS components, and between PPS and other HOSC services.

6.2.3.7 CPS to EDR Interface Tool (CEIT) Services

CEIT services provide the capability to move PPS data between the EDR database and CPS-formatted import/export files.

6.2.3.8 PPS Utility Functions

PPS utility functions provide any additional minor services needed to effectively utilize the major PPS services. An example is the HOSC Data Set (HDS) utility, which is required to implement the interface between PPS and EHS.

6.2.4 STS-Provided Systems

6.2.4.1 Meteorological Interactive Data Display System (MIDDS)

The MIDDS integrates diverse weather data on a single display terminal—satellite images, radar, computer generated graphics of surface and upper air map features, numerical weather models, current weather observations, data from meteorological towers, lightning strikes and field mill information. The MIDDS is a Shuttle Program-provided system, and the HOSC Project is responsible to provide hosting services for the MIDDS only.

6.2.4.2 PC-GOAL

The Personal Computer (PC) Ground Operations Application Language (GOAL) system, provided by KSC, provides the display and monitor capability to support multiple-discipline user operations in real-time. It is used to monitor prelaunch vehicle processing, checkout real-time launch commit criteria anomalies, and monitor in-orbit activities.

6.3 ALLOCATION OF THE PROJECT REQUIREMENTS TO THE SYSTEM

The allocation of the customer requirements (by WBS element) to the system architecture elements is provided in Figure 6.3-1.

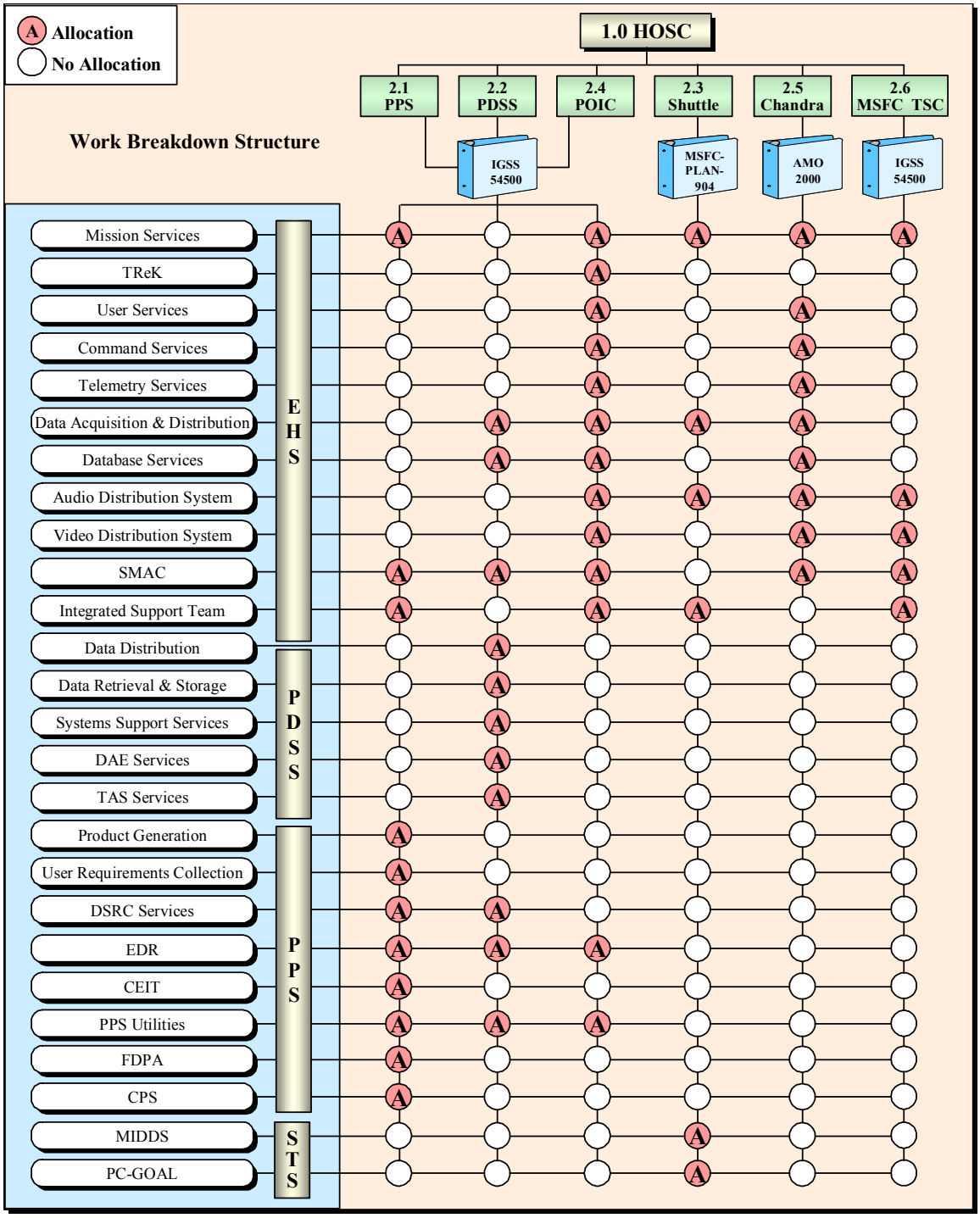

Figure 6.3-1. System Requirements Allocation

6.4 SYSTEM OPERATIONS CONCEPT

The HOSC Project develops systems that provide continuous and efficient spacecraft/payload operations support in accordance with customer requirements and agency budget constraints. The HOSC Users Handbook, HOSC-HUH-233, provides guidance on dealing with operations customers. The POIC Capabilities Document, SSP 50304, describes the services available as well as backup and redundancy capabilities.

In general, the HOSC Project provides three basic types of support to its customers: "real-time systems," "systems operations," and "off-line," as illustrated in Figure 6.4-1.

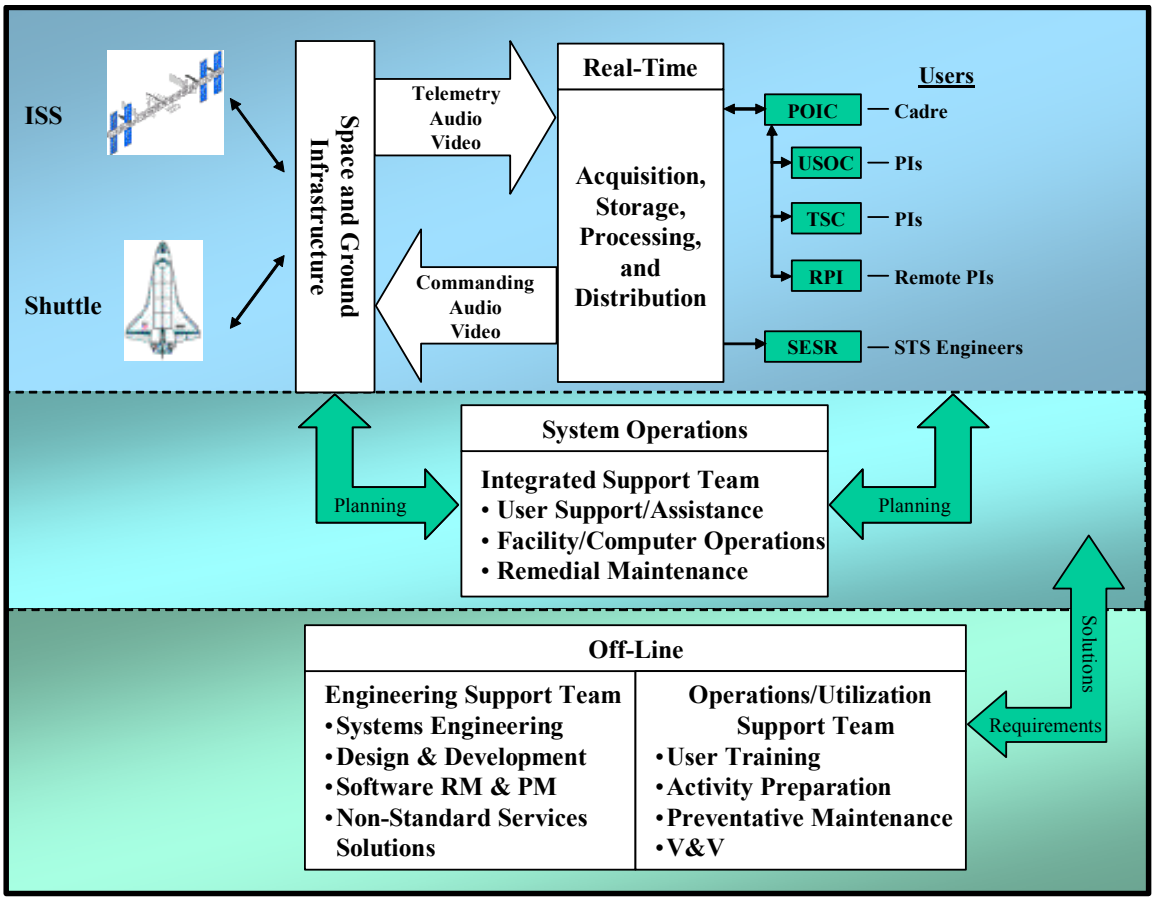

Figure 6.4-1. Operations Concept

Real-time systems provide activities/capabilities which involve the immediate processing of data as it is received from the on-orbit payload or vehicle (telemetry, audio, and video). The on-orbit payload or vehicle data is routed through the space and ground networks. The HOSC Project provides the systems, which acquire the data from the on-orbit sources, store it, perform any required processing on the data and distribute it to the users with minimal latency. The users are located in the POIC, USOC, TSC, and in the home locations of the many Principal Investigators (PI). The users view the data via HOSC-provided EHS or TReK services and/or

using their own ground support equipment (GSE). Commands, which are generated on-line or off-line, are uplinked using EHS or TReK workstations and/or user GSE.

System operations activities are performed by a staff of ground personnel known as the Integrated Support Team (IST) and are essential in the execution of real-time systems. The IST operates the HOSC systems, monitors systems performance, takes action to correct evolving problems, plans resources utilization, and assists on-line users.

Off-line activities are conducted to ensure systems and personnel preparedness to conduct real-time operations. Off-line activities include such items as:

- Preventative maintenance of system components,
- Training users and IST on HOSC Project systems,
- Developing telemetry and command databases, and
- Verifying/validating HOSC system upgrades and developing system upgrades.

6.5 SYSTEM CONSTRAINTS

The constraints for the HOSC Project are identified in Figure 6.5-1. These constraints share similar characteristics in that increasing the provided capability represents a non-trivial increase in funding and require a minimum of one year to provide this increase.

Program(s)	Facility, System, or Service	Constraint
ISS	PDSS	Average composite data rates > 10 Mb/s for two-year storage requirement
ISS	PDSS	Composite downlink rate > 75 Mb/s will impact front-end processors

Figure 6.5-1. Systems Constraints

6.6 FACILITIES

The HOSC Project develops and operates facilities and systems, which are located at the MSFC, as depicted in Figure 6.6-1.

Figure 6.6-1. HOSC Project and Supported Facilities

These MSFC facilities are defined in MSFC-PLAN-904, MSFC-HDBK-003 and HOSC-MCD-1200. In addition, the Project provides EHS systems and sustaining engineering to:

- The CXO Operations Control Center/Engineering Support Center, and
- The KSC Payload Checkout and Test System (PCTS).

TReK systems and sustaining engineering are provided to PIs located across the United States.

The Project provides *data, command, audio, and video* to numerous locations, as illustrated in Figure 6.6-2 for the ISS Program.

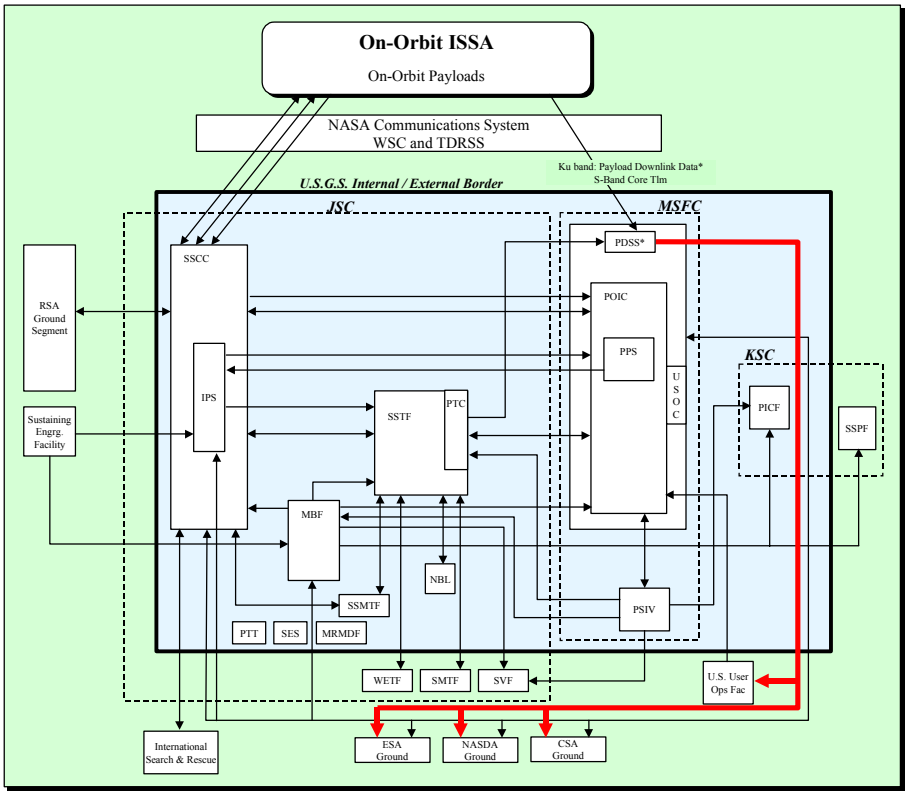

Figure 6.6-2. ISS Space and Ground Systems Support Overview

Recipients include the European Space Agency (ESA), Japanese Space Agency (NASDA), Canadian Space Agency (CSA), and numerous PIs located throughout the United States.

The HOSC Project and related facilities located at or near MSFC are shown in Figure 6.6-3.

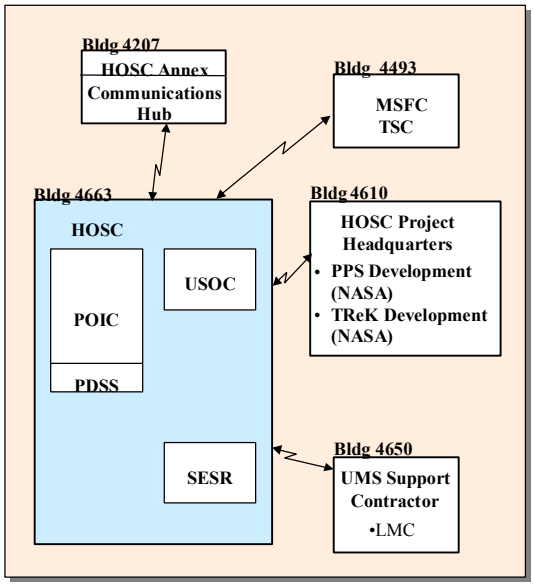

Figure 6.6-3. HOSC/MSFC Facilities Overview

6.7 LOGISTICS CONCEPT

The HOSC logistics concept is based on extensive experience in development and operations of spacecraft ground support systems and facilities and in satisfying the needs of science and engineering users. Safety and mission assurance are the primary concerns as multiple missions, payloads and experiments are concurrently planned, prepared for and supported.

In overview, these activities include the interaction of several types of work:

1. Sustaining engineering of the system to accommodate mission- specific capabilities and upgrades/ enhancements.

2. Integration of and preparation for the various requirements of the manifested mission stackup.

3. Preparation for and support of a specific mission.

This interaction is conceptualized in Figure 6.7-1.

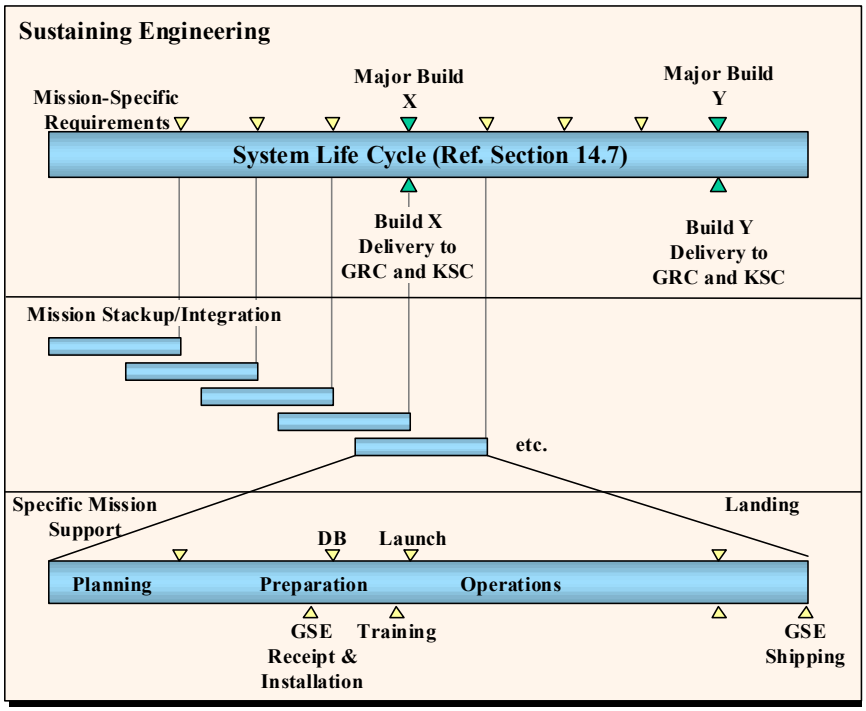

Figure 6.7-1. Conceptual Logistics Timeline

All of the work depicted in the figure is carried out using the GSD implementation of the ISO-9000 standard, as synopsized in Section 14.

Sustaining engineering logistics:

- Hardware and software support personnel are primarily provided by support contractors.
- Hardware and software items are procured using MSFC Procurement Office services.

Mission stackup/integration logistics:

- Facility space allocations to customers/missions is scheduled by the HOSC Scheduling Office.

Mission-specific support logistics:

- Database inputs are provided by the users/PIs, validated, integrated, and loaded by the HOSC Database Team.
- Ground Support Equipment (GSE) is shipped by the users/PIs to the USOC. The users/PIs unpack and repack the GSE. The IST coordinates installation and uninstallation.

6.8 MISSION RESULTS ANALYSIS AND REPORTING

Results analysis and reporting are daily activities for all missions supported. Problems are identified and corrected on a routine basis to ensure mission success. Following operations utilization, a post-activity debrief is conducted to assess success and identify problems encountered and need for corrective action.

7.0 SCHEDULES

The top-level HOSC Project schedule by WBS element is provided in Figure 7.0-1.

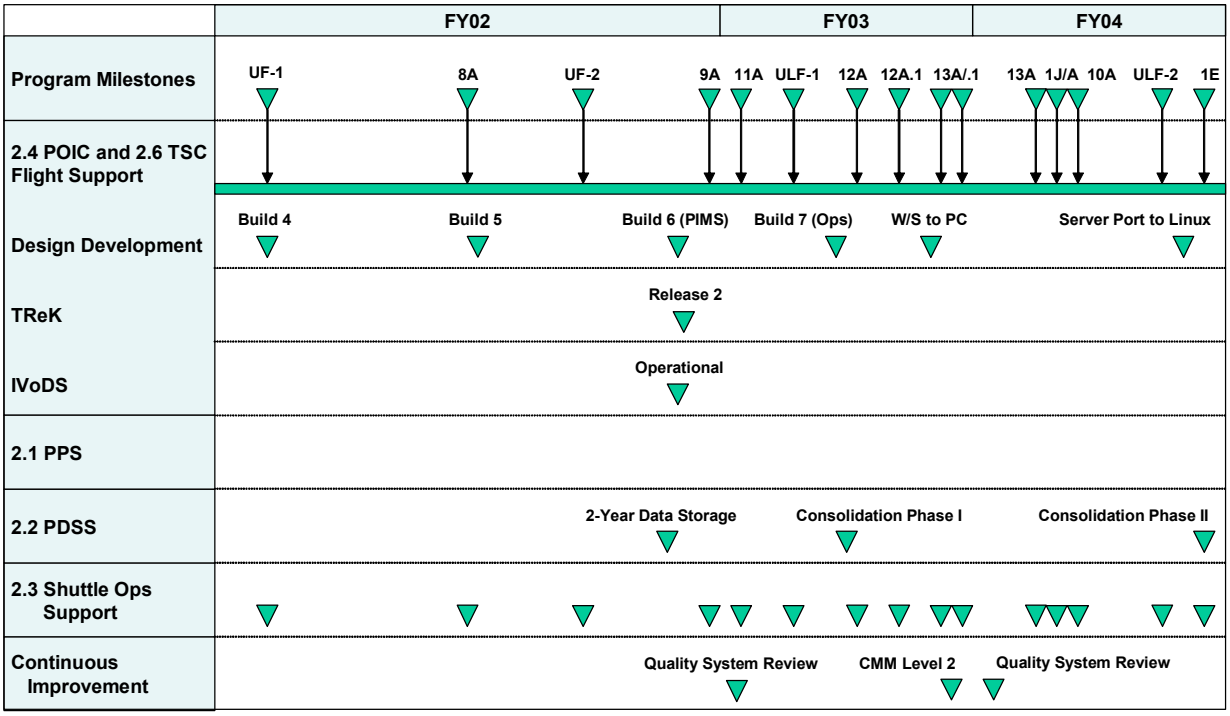

Figure 7.0-1. Project Schedule

In general,

- ISS-related facilities/systems are being developed in successive "builds," each of which leverages the capabilities of previous "builds" to achieve the required overall capability. Enhancements are being made to the systems to improve the overall performance and cost of ownership. ISS flight segments utilize the successive builds, thus providing ever increasing verification and validation of the operational capabilities.
- MSFC TSC support capabilities are similarly being developed in successive builds with ever increasing V&V of the operational capabilities.
- Shuttle support is in a sustaining mode with missions and tests being supported as required.
- Chandra support is in a sustaining mode
- Major reviews are scheduled as required by the MSFC PMC and NPG 7120.5.

HOSC Project Schedules are reviewed and discussed in Section 5.3.3.

8.0 RESOURCES

8.1 FUNDING REQUIREMENTS

The HOSC Project budget is shown in FY99 dollars ($K) in Figure 8.1-1.

WBS Element	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09
2.1 PPS	1,310	1,100	1,400	1,550	875	525	450	450	450
PPS Reserve	0	0	0	0	0	0	0	0	0
2.2 PDSS	Dollars combined with POIC (2.4)								
PDSS Reserve	0	0	0	0	0	0	0	0	0
2.3 Shuttle	783	832	848.5	866.9	884.3	903.7	924.2	942.5	
Shuttle Reserve	0	0	0	0	0	0	0	0	0
2.4 POIC	12,750	20,572	19,750	19,350	18,026	17,328	18,133	19,041	19,369
POIC Reserve	0	0	0	0	0	0	0	0	0
2.5 Chandra	-	90	90	90	90	90	90		
Chandra Reserve	0	0	0	0	0	0	0	0	0
2.6 MSFC TSC	356	170	157	160	160	160	160	160	
MSFC TSC Reserve	0	0	0	0	0	0	0	0	0
2.7 PDL	1,300	2,125							
PDL Reserve	0	0	0	0	0	0	0	0	0

Figure 8.1-1. HOSC Project Budget

8.2 CIVIL SERVICE WORKFORCE

The HOSC Project requirements for civil service workforce are summarized in Figure 8.2-1.

WBS Element	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09
2.1 PPS	14.9	16.8	18.1	13.1	7.1	5.1	5.1	5.1	5.1
2.2 PDSS	Combined with POIC (2.4)								
2.3 Shuttle	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
2.4 POIC	31.2	26.9	36.6	27	24	18	18	18	18
2.5 Chandra	0.5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2.6 MSFC TSC	0.5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2.7 PDL	1.2	2.1							

Figure 8.2-1. Civil Service Workforce

9.0 CONTROLS

Comprehensive project controls are in-place as prescribed by NPG 7120.5A and illustrated in Figure 9.0-1. Those which are addressed elsewhere in this Plan are shown at the bottom of the figure with section references. Those at the top of the figure are discussed in the following paragraphs.

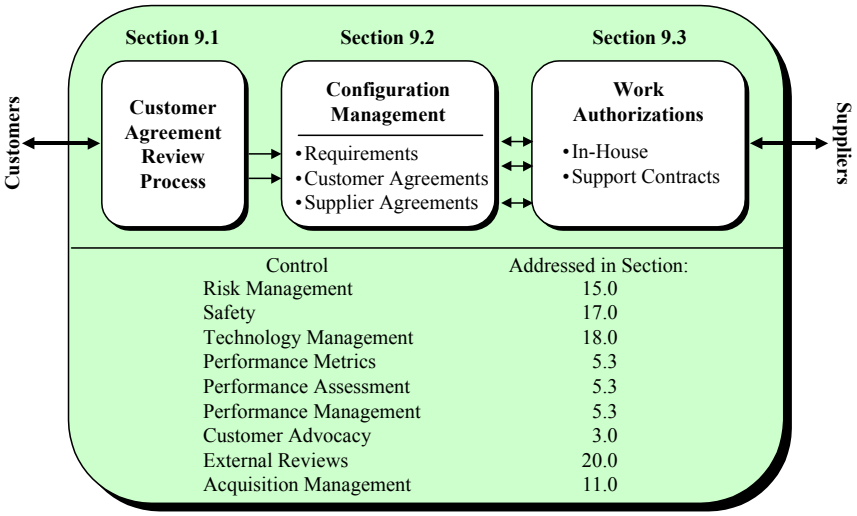

Figure 9.0-1. Controls Overview

9.1 CUSTOMER AGREEMENT REVIEW PROCESS

The HOSC Project has been ongoing, spanning many years and successfully supporting many Programs and Projects. It has defined the system requirements (Level III) necessary to accommodate the customer performance requirements (Level I/II) as described in Section 6. These Level III system requirements, for the generic and Program/Project-specific system requirements respectively, are discussed in Section 1.3 of this plan.

Customer requirements (Level I/II) evolve over time (measured in years) as the customer completes definition of Program and end-user requirements. As a result, the HOSC Project (Level III) requirements similarly evolve over time. These (Level III) evolutions result in technical changes to planned configuration implementations and these changes result in impacts to resources, budgets, and schedules.

Customer requirements (Level I/II) and customer requirements evolutions are handled/book-kept using the Customer Agreement Review Process, in accordance with MPG 1050.1, and HOSC Quality Plan, Section 7.1.3, and as shown in Figure 9.1-1. This process is initiated by the customers annually to correspond with Program Operating Plan (POP) cycles. It may also be initiated at other times by the customer – to define new/changed requirements, or by the HOSC Project – to identify Level III changes derived during implementation. The process results in commitments of funds from the customer (Program) in return for products and services on a defined schedule from the HOSC Project.

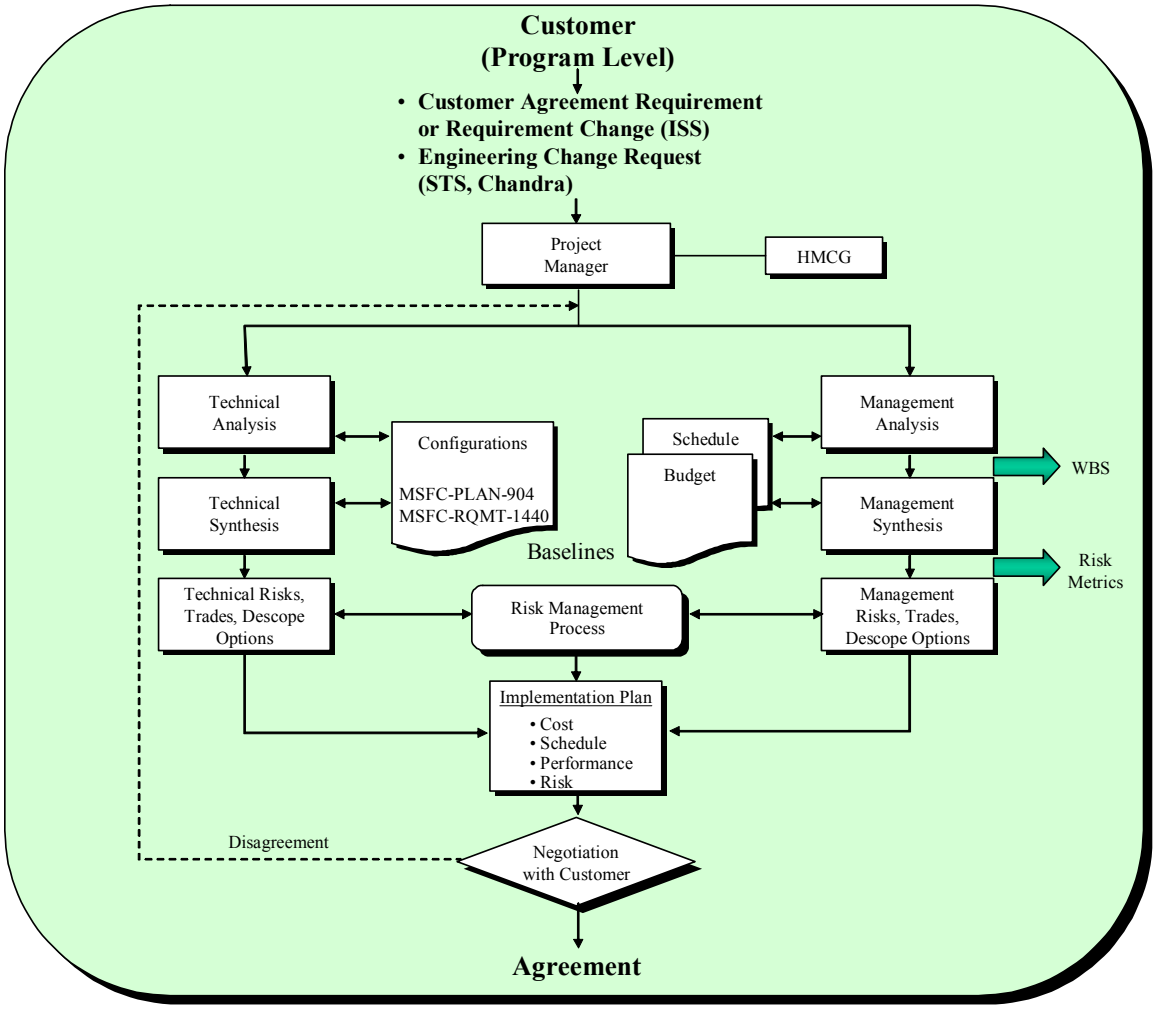

Figure 9.1-1. Customer Agreement Review Process

The principal function of this process is to ensure understanding of the customer (Level I/II) requirements or changes, so that changes to the (Level III) implementation requirements (identified in Section 1.3) can be derived in terms of cost, schedule, and risk. In executing this process, inputs are solicited from suppliers, such as support contractors and NASA/MSFC organizations (ex. NISN), as well as from in-house subject matter experts. All inputs are validated for compliance with program requirements by the GSD. The result of the process is an executed customer agreement and collaborative work commitment, which defines estimated cost and schedule to meet the broadly defined performance requirements. Approvals of customer agreements are defined by the lines of authority described in Section 4.

9.2 CONFIGURATION MANAGEMENT

Systems, facilities, and procedure configuration management is conducted as described in MSFC-PLAN-2929 – Configuration Management Plan for Huntsville Operations Support Center.

Configuration management of customer agreement requirements, schedules, and budgets is conducted as described in Section 9.1 above.

Configuration management of supplier agreements (contracts) is conducted as described in Section 9.3 below.

9.3 WORK AUTHORIZATION

The HOSC Project authorizes work in a manner which ensures flowdown of customer agreement requirement, budget, and schedule commitments. Work allocation is based on the availability of expertise, with some assignments being made to in-house personnel and some assignments being made to support contractors.

In-house – The work involved in executing the management processes described in this Plan, overall systems engineering, the Telescience Resource Kit (TReK) development, and elements of the PPS are performed by the civil service workforce. This work is authorized using the collaborative work commitment process, which describes the assigned work, budgeted hours, and schedule. Performance against the requirements is managed using the MSFC Employee Performance Plan process.

Support Contracts – Systems, facility and procedure development, sustaining engineering, and operations services are provided by support contractors, as described in Section 11. This work is authorized through competitive procurement in accordance with the Federal Acquisition Regulations (FAR). The solicitations define supplier agreements and include broadly defined scopes of work, which are flowed down from HOSC Project customer agreements. Flowdowns include schedule requirements/constraints and workload indicators, such as Software Lines of Code (SLOC) to be developed/maintained and operations shift coverage requirements. Contractor cost estimates are based on the technical, schedule, and workload requirements. Contracts are awarded based on best value to the government in terms of technical, management, risk, and cost parameters. These contracts (work authorizations) are baselined through negotiation to include scope, schedule, and cost metrics.

Contract performance is evaluated based on the contractors' delivery of the specified products and services on the required schedule and within the negotiated cost. Performance is monitored/evaluated based on the metrics defined in Section 5.3.3.

10.0 IMPLEMENTATION APPROACH

The overall technical and management implementation approaches are as discussed in Section 1.3. The following paragraphs describe the roles of the various organizations involved in HOSC Project implementation and their assignments in support of WBS elements.

10.1 PROJECT IMPLEMENTATION

The overall role of the GSD/HOSC Project is illustrated in Figure 10.1-1.

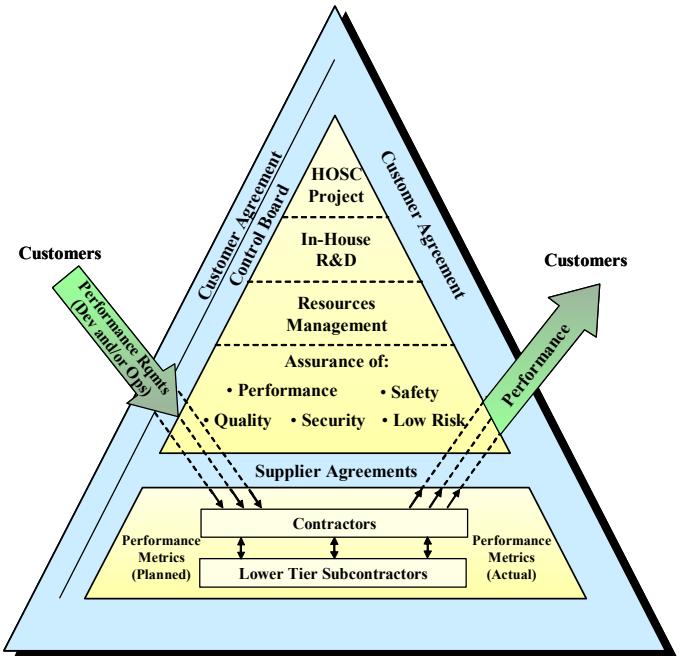

Figure 10.1-1. Implementation Overview

In general, the GSD/HOSC Project:

- Interfaces with the customers/ Programs,
- Defines and commits to performance requirements in terms of technical, schedule, and budget parameters,
- Allocates work element to civil service and contractor organizations,
- Conducts development of the TReK systems and PPS Product Generation (PG) components and utilities,
- Ensures performance in line with commitments,
- Exercises control to mitigate risks, and
- Ensures the quality of delivered products and services.

Supporting contractors provide system and mission life cycle support services including:

- Contract management,
- Systems Engineering support,
- Design and development,
- Activity preparation,
- Operations,
- Hardware and software maintenance, and
- Verification.

Details of these service requirements are included in the respective contracts.

10.2 PROJECT SUMMARY WBS

The project work breakdown structure is defined to correspond to the HOSC Project budget line items, as shown in Figure 10.2-1. The requirements associated with the WBS elements are allocated to the organization, as shown in Figure 5.1-2. The GSD Groups and Teams are supported by the contractors as also shown in Figure 5.1-2.

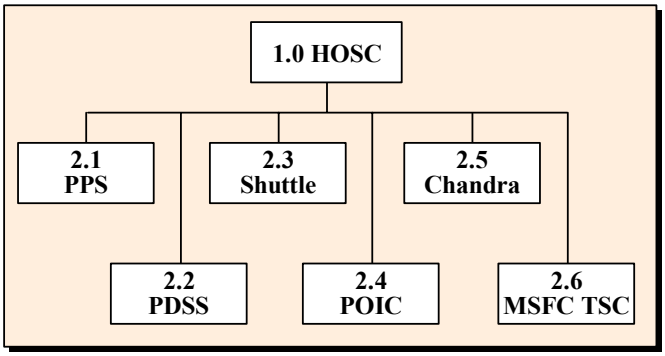

Figure 10.2-1. Project Summary WBS

11.0 ACQUISITION SUMMARY

The HOSC Project is implemented using Government and contractor resources. The specific HOSC Project elements are identified in Figure 11.0-1.

HOSC Project Element	Contract Support
PDSS	UMS
PPS PG, URC, DSRC, CEIT, and EDR CPS and FDPA	 UMS/NASA NASA/JSC
POIC/USOC EHS TReK	 UMS NASA
Chandra	UMS
MSFC TSC	UMS
Shuttle Engineering Support Room	UMS

Figure 11.0-1. HOSC Project Acquisition Plan

Specifics on the support contract are provided in Figure 11.0-2.

Item	UMS
Contract Number	NAS8-44000
Type of Procurement	Competitive
Type of Contract	CPAF
Source	Lockheed Martin Engineering and Sciences
Procuring Activity	MSFC
Technical Monitoring	MSFC/GSD

Figure 11.0-2. Support Contract

12.0 PROGRAM/PROJECT DEPENDENCIES

The HOSC Project is well into the implementation phase of all its development activities. No significant dependency on any technology maturation remains. The principal dependencies involve organizations delivering products on time and on budget, as discussed below.

12.1 EXTERNAL DEPENDENCIES

HOSC Project interdependencies with external organizations are shown in Figure 12.1-1 along with mitigation activities which are conducted to manage risks.

Dependency	Dependent	Dependent On	Mitigation
Funding	HOSC Project	Programs	Timely, high quality performance
Requirements/ICDs	HOSC Project	Programs	Proactivity in definition
PPS, POIC, USOC, PDSS, and TReK	ISS Program	HOSC Project	Regular reviews, fund/schedule budgets
PPS: CPS and FPDA	HOSC Project	JSC	Regular reviews
EHS System	CXO OCC	HOSC Project	Regular reviews
EHS System	KSC PCTS	HOSC Project	Regular reviews
MSFC TSC/EHS System	MSFC Science Directorate	HOSC Project	Regular reviews, fund/schedule budgets
Shuttle Support	MSFC SPD	HOSC Project	Regular reviews, fund/schedule budgets
MIDDS System	HOSC Project	Shuttle Program	Regular validation testing
PC-GOAL System	HOSC Project	KSC	Regular validation testing

Figure 12.1-1. External Dependencies

Operational dependencies are illustrated in Figure 12.1-2.

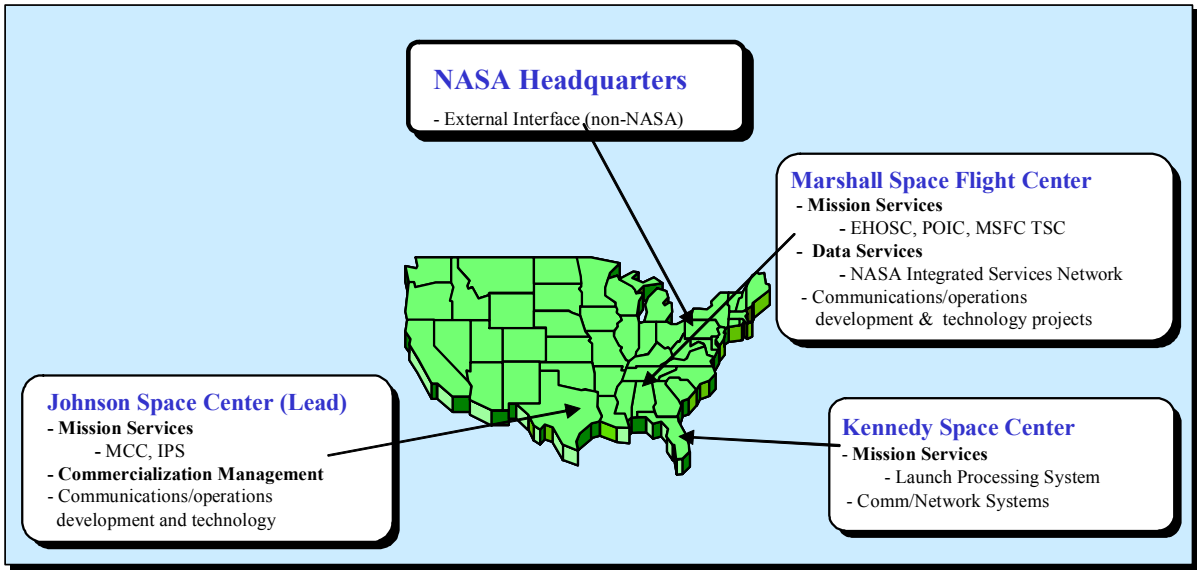

Figure 12.1-2. ISS Operations Dependencies

12.2 INTERNAL DEPENDENCIES

Internal interdependencies are shown in Figure 12.2-1 along with mitigation activities which are conducted to manage risks.

Dependency	Dependent	Dependent On	Mitigation
SW/HW Build Deliveries (POIC, USOC, PDSS, PPS)	HOSC Project	Lockheed Martin	Regular reviews, fund/schedule budgets
TReK HW/SW Deliveries	HOSC Project	FD41	Regular reviews, fund/schedule budgets

Figure 12.2-1. Internal Dependencies

13.0 AGREEMENTS

13.1 NASA AGREEMENTS

HOSC Project Agreements with NASA organizations are as follows:

- Technical Task Agreements (TTA) are in place between the Flight Projects Directorate (FPD) and the ISS Program for PPS, PDSS, and POIC subsystem support. These are flowed-down to the GSD using Collaborative Work Commitments (CWC)

– generally one CWC per subsystem/WBS element.

- CWC's are likewise in place between the FPD/GSD and the CXO, Shuttle Projects Office and the Microgravity Science and Applications Department for Chandra, Shuttle and TSC support respectively. These correspond to the Shuttle and TSC WBS elements.
- A TTA is in place between the FPD/GSD and OZ/JSC/MOD for CPS and FPDA support.
- A Memoranda of Agreement is in place between MSFC and KSC for GSD delivery of software and support for payload testing at the KSC PTCS.

In order to fulfill Space Station Program international agreements, it may be necessary to export technical information, software, or hardware. These exports will be conducted in accordance with MPD 2190.1, MSFC Export Control Program.

13.2 NON-NASA AGREEMENTS

There are no non-NASA agreements for this project.

14.0 PERFORMANCE ASSURANCE

This section provides an overview of the approach for ensuring that the customer requirements will be reliably satisfied.

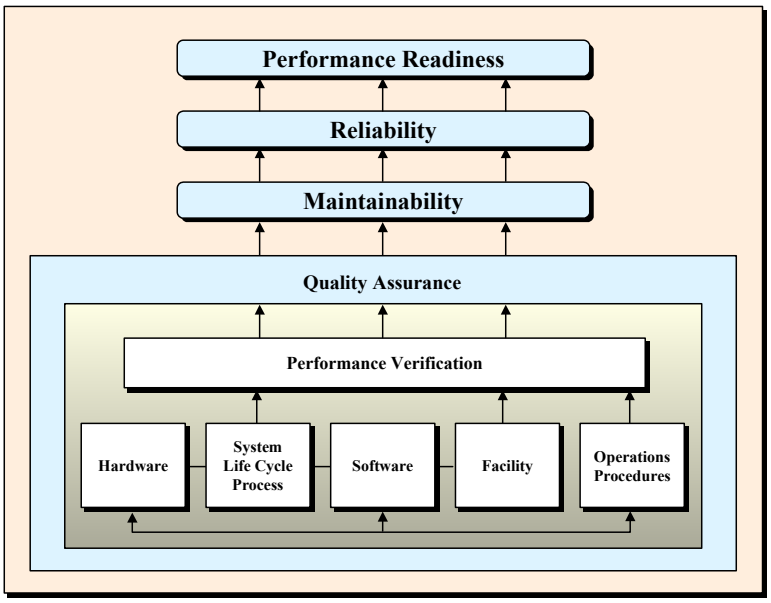

Figure 14.1-1. Performance Assurance Overview

14.1 GENERAL

Performance assurance is the driving force/objective in all of the HOSC Project work activities and processes. Figure 14.1-1 provides an overview of how the major processes and systems combine to assure readiness to satisfy customer requirements. Hardware and software are developed using the life cycle process. Facilities, procedures and HW/SW are verified/validated by rigorous quality assurance, which ensures that the required maintainability, reliability and readiness objectives are met prior to ORR.

The following paragraphs address each element of the figure.

14.2 PERFORMANCE READINESS

Mission support/performance readiness is defined as the state of preparedness wherein the HOSC Project is capable of delivering the facilities, systems, and services required by the customer agreements and augmented by the end-to-end performance requirements. These requirements are discussed in Section 6 and are governed by customer-defined support readiness dates, as defined in the customer agreements. End-to-end performance requirements are defined in MSFC-RQMT-1440, Section 2.3.

14.3 RELIABILITY

Mission support readiness is dependent on the reliability of the facilities, systems, and support personnel to deliver required products and services. The reliability of the facilities is ensured through dedication of facilities for the purposes of the requirements support and through managing them under configuration control, as defined in MSFC-PLAN-2929. The reliability of the support personnel is ensured through personnel being certified to execute the support procedures, as defined in FPD-OI-FD43.1, Ground System Operations. The reliability of the systems is dependent on their availability (up time) and the availability requirements are defined in MSFC-RQMT-1440, Section 2.4.

14.4 MAINTAINABILITY

HOSC facility and system reliability/availability are dependent on their being easily maintainable. That is, they must be constructed to ensure serviceability with minimum skills, test equipment and maintenance cost, and they must be built to ensure the ability to detect, isolate, and repair faults promptly to minimize downtime.

Facility maintainability is ensured through utilizing the professional services of the MSFC Facilities Engineering Department for facility life cycle support.

System maintainability is ensured through:

- Modular design with built-in redundancies,
- Extensive use of commercial-off-the-shelf (COTS) products, as described in MSFC-RQMT-1440 Sections 2.1 and 2.2,
- Utilization of disciplined processes for quality assurance and verification, as described in Sections 14.5 and 14.6 below,
- Utilization of a disciplined process for system development and documentation as described in Section 14.7 below, and
- Implementation of the System Monitor and Control (SMAC) system, which is specifically designed to detect and isolate system faults, as defined in MSFC-RQMT-1440, Section 13.

14.5 QUALITY ASSURANCE

Performance readiness, reliability/availability and maintainability are dependent on comprehensive quality assurance for all HOSC Project products and services. HOSC Project quality assurance is performed in accordance with ISO 9000 requirements, as documented in the HOSC Project Quality Plan, HOSC-PLAN-661. This plan provides a roadmap to the documented policies and processes which govern all aspects of program life cycle support. HOSC product and service quality is measured using customer surveys.

14.6 PERFORMANCE VERIFICATION

Facilities, systems, and personnel/procedural performance verification methodologies are illustrated in Figure 14.6-1.

Category	Methodologies	Reference
Facilities	Testing Preceding ORR and HRR	HOSC-PROC-180
Systems	Testing/V&V Audits and Reviews	MSFC-PLAN-2929
Personnel	Successful Completion of Certification Requirements	FPD-OI-FD43.1
Procedural	Execution of Procedures during Verification Cycle and then through Simulation	HOSC-PROC-163
Overall	As defined in the Quality Plan	HOSC-PLAN-661

Figure 14.6-1. Verification Methodologies

14.7 SYSTEM LIFE CYCLE PROCESS

Systems are comprised of: computer, audio and video hardware; networking/ communications hardware; and associated software. Systems are also considered to include the documentation which describes them. In accordance with HOSC quality assurance, configuration management, and performance verification requirements, all systems are developed and operated using the life cycle process summarized in Figure 14.7-1. (The life cycle process is described in detail in the Configuration Management Plan.)

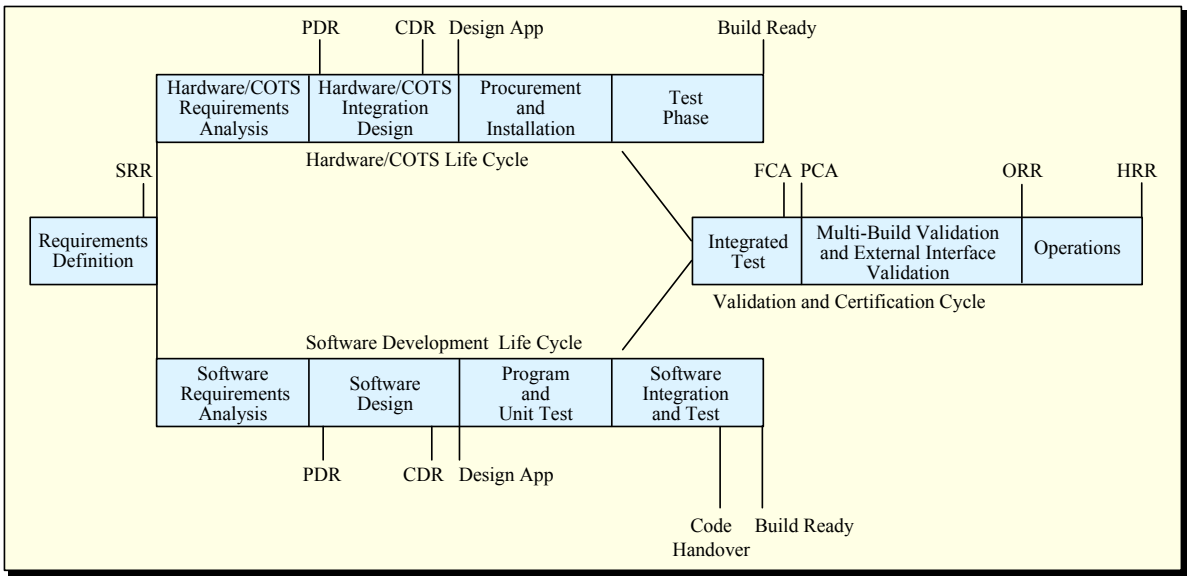

Figure 14.7-1. System Life Cycle Process

Baselines, technical reviews and audits are utilized at various times during the life cycle to define, control, and maintain configuration. Performance readiness/operations begins after all verification and validations are completed. During the operations phase, configuration management operations continue to maintain the latest configuration baseline.

14.7.1 Hardware

The vast majority of HOSC hardware systems, subsystems, and components are industry standard, commercial-off-the-shelf, and of modular construction as described in MSFC-RQMT-1440, Section 2. Industry standards are employed for hardware integration/networking. All hardware is documented and configuration controlled per MSFC-PLAN-2929. Non-standard hardware is procured with full documentation. The GSD maintains in-house expertise in all hardware areas.

14.7.2 Software

The HOSC software systems are based on COTS subsystems and components, and unique software is developed using industry standard high level languages, as described in

MSFC-RQMT-1440, Section 2. All software is documented and configuration controlled per MSFC-PLAN-2929. Software is procured with full documentation. The GSD maintains in-house expertise in all software areas.

14.8 FACILITIES

HOSC facilities are specifically designed to accommodate around-the-clock operational support as required in the customer agreements.

14.9 OPERATIONS PROCEDURES

HOSC operations procedures are specifically tailored to ensure that customer requirements are met. These procedures support all phases of the systems and facility life cycles and are focused on ensuring/validating initial and on-going operational support readiness, as described in FPD-OI-FD43.1, Ground Systems Operations.

The personnel who execute the operations procedures are trained and certified, as also described in FPD-OI-FD43.1, Ground Systems Operations. This training and certification includes all aspects of operational customer and systems support - from initial analysis of requirements through mission results analysis and reporting. The GSD maintains in-house expertise in all operations areas and closely monitors operational utilization.

15.0 RISK MANAGEMENT

HOSC Project risk management is in accordance with HOSC-PLAN-635, which in-turn satisfies the requirements of NPG 7120.5.

16.0 ENVIRONMENTAL IMPACT

There are no environmental impacts associated with the HOSC Project.

17.0 SAFETY

HOSC Project compliance with safety requirements is defined in HOSC Quality Plan, Section 7.8.8 – Safety. This includes compliance with the requirements of MWI 1700.1, Payload Safety Readiness Review Board and of SSP 54500, International Ground System Requirements, including SSCN 537, Hazardous Commanding, and NSTS/ISS 18798 Interpretations of NSTS/ISS Payload Safety Requirements, Section 4.2, Payload Commanding – POCC (TA-91-062).

18.0 TECHNOLOGY ASSESSMENT

A number of new technologies will be incorporated by commercially available or developed (uniquely) by the HOSC Project. These technologies are discussed in the following paragraphs.

Unique Technologies

A high data rate, 50 Mbs front-end processor (FEP) is planned to be developed and upgraded to provide 150 Mbs processing. The FEP processes the Ku-band ISS telemetry downlink and converts data into standard packets for distribution to the POIC systems and to external U.S. and International Partner payload sites.

The technologies to provide a generic, packet-based telemetry and command processing system will be developed. This generic system will provide the capabilities necessary to command and control payloads and spacecraft systems.

Two additional technologies have been developed to enable low-cost, remote telescience operations. A PC-based system, called the Telescience Resource Kit (TReK), processes telemetry packets and to generate uplink commands/files. Additionally, a technology has been developed to do multiple voice loops from a single PC-based voice-over-internet protocol system (Internet Voice Distribution System (IVoDS)).

Commercially Available

A number of commercial technologies will be used by the HOSC Project and are summarized in Figure 18.0-1.

Need	Technology Employed
Telemetry/Command Routing	Standard Network and Communications Protocols: TCP/IP, Ethernet
Distributed, End-User Computing	RISC-based Workstations and Servers migrating to Linux/Intel servers and Windows/Intel desktop systems
Monitor and Control of Network/Communication Systems Assets	Network Management Systems Based on Simple Network Management Protocol
Flexible Database Table Development and Access	Relational Database Management Systems

Figure 18.0-1. Commercial Technologies

19.0 COMMERCIALIZATION OPTIONS

One technology will be developed by the HOSC Project which will have the potential to be marketed commercially by the vendors. This technology is identified in Figure 19.0-1 below.

Technology	Company	Commercialization Description
Internet Voice Distribution System (IVoDS)	AZ Technology 4901 Corporate Drive, Suite 101 Huntsville, AL 35805	PCI-based cards for connection to Personal Computers

Figure 19.0-1. Commercialization Items

20.0 REVIEWS

The various reviews are identified in Figure 20.0-1 to include the name, purpose, content, and timing of each.

Name	Purpose/Content	Timing
MSFC PMC	Management Review	Annual
SMO/PMC Management Review	Independent Evaluation	Periodic
IAR	Independent Evaluation	Annual
FPD Management	Presentation of management/technical status and plans to Program Management	Quarterly
HMCG	Configuration Management of HOSC Systems and Resources	Monthly
MRB	Review/disposition risks; ensure focus on quality objectives; ensure quality system continuous improvement to achieve customer satisfaction	Monthly
HOCG	To management configuration and utilization of HOSC Resources	Twice Monthly
DBCG	Review and disposition proposed changes to databases	Weekly
HSM	Review HOSC configuration requests and provide daily status	Daily
UMS Contract PEB	To evaluate contract performance (technical, schedule, and cost) and establish award fee for performance period	Semi Annual
Boeing Contract PEB	To evaluate contract performance (technical, schedule, and cost) and establish award fee for performance period	Semi Annual

Figure 20.0-1. Reviews

21.0 TAILORING

This plan addresses all of the requirements of NPG 7120.5. Tailoring has been applied as follows:

- Project cost and schedule reserves are not maintained as these are not made available by the HOSC Project's customers.
- Earned value management is not applied as it is waived by all the HOSC Project customers.

APPENDIX A– HISTORY

The HOSC has provided essential and successful facilities, systems and/or services for numerous NASA Programs, since the late 1950s as illustrated below.

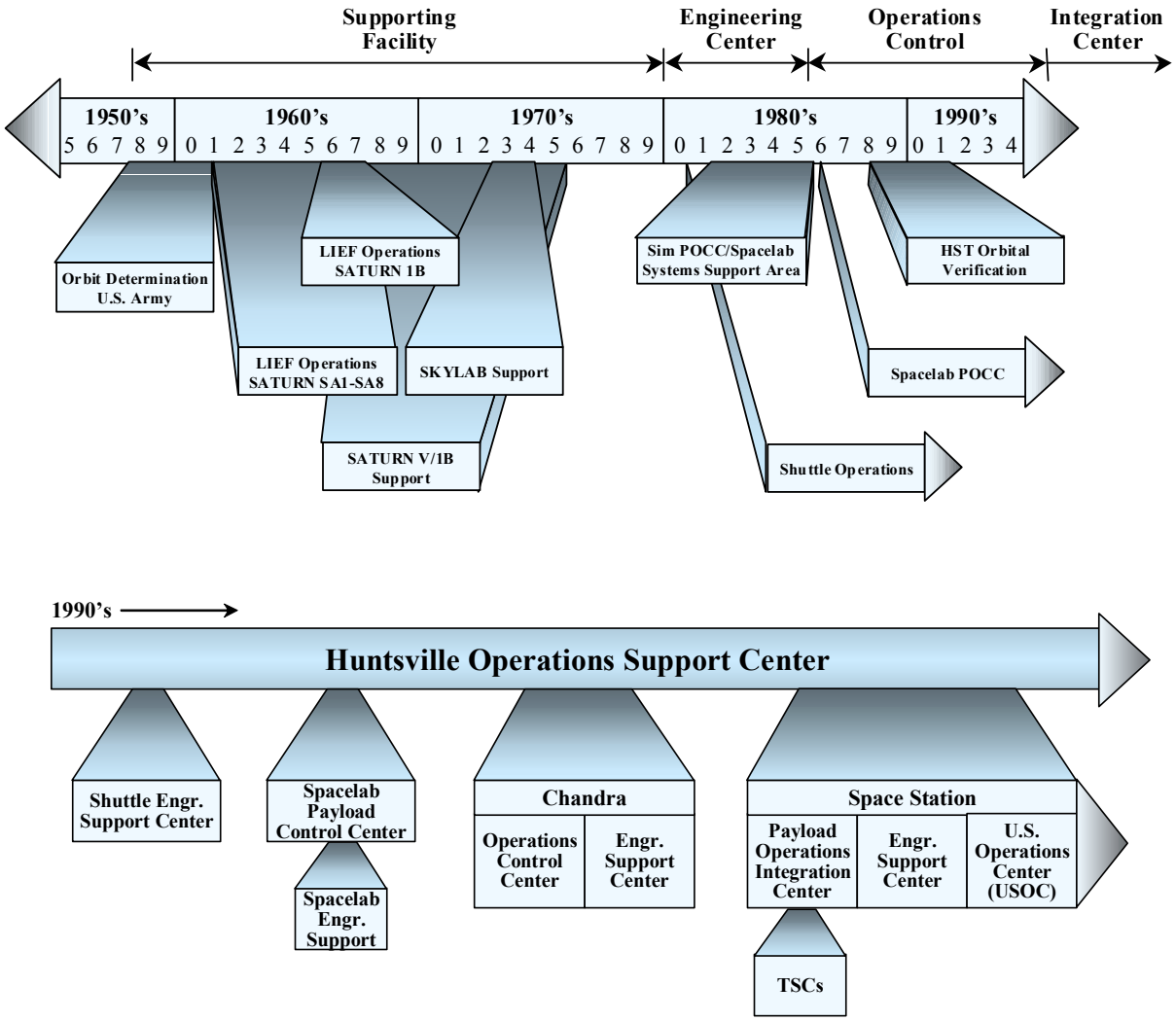

Figure A-1. HOSC History

Highlights are as follows:

- **Shuttle:**
  - Pre-Launch/Launch Engineering Support for MSFC responsible systems (Main Engine, SRB, ET and MIDDS)
  - Support incrementally scheduled.
- **Spacelab and Shuttle Payloads:**
  - On-Orbit Engineering Support for MSFC responsible systems
  - On-Orbit Payload Control, Science Operations, Mission Planning
  - Pre-Mission preparation activities: training, simulations, mission planning, KSC payload integration (MST, CLT, ETE)
  - Support incrementally scheduled.
- **ISS:**
  - On-Orbit Engineering Support
  - On-Orbit Integrated Payload Control and Planning for both manned and unmanned configurations
  - Pre-Mission preparation activities: training, payload planning, simulations
  - Facility/Data support continuous
  - Payload Control incrementally scheduled during both manned and unmanned configurations.
- **Chandra:**
  - On-Orbit Engineering Analysis and Control System
  - Observatory Science Operations Control and Mission Planning System
  - Data Processing and Capture System
  - Pre-Mission preparation activities: training, simulations, integrated testing
  - OCC technical support team support.

APPENDIX B – RESPONSIBILITIES

The following is an excerpt from NPG 7120.5.

B.1 HEADQUARTERS RESPONSIBILITIES

A. The Administrator is responsible for the following:

1. Agency-level strategic management.
2. Overall Agency program budget allocation.
3. Approval of all programs for new starts.
4. Oversight of NASA programs.
5. Leading customer interfacing.

B. The Deputy Administrator is responsible for the following:

1. Supporting the Administrator in his/her responsibilities for overall NASA strategic management, budget allocation, and oversight, including new-start approval.
2. Developing Agency-level PPM policy, processes, and requirements and providing oversight of their implementation.
3. Assessing candidate new-start readiness.
4. Recommending which programs will be overseen by the NASA PMC.
5. Ensuring timely resolution of multiple Enterprise program and project issues.
6. Serving as chairperson of the Agency's PMC and CIC.
7. Serving as the Acquisition Executive for the Agency.

C. Enterprise Associate Administrators are responsible for the following:

1. Providing program advocacy.
2. Establishing program objectives, requirements, and metrics.
3. Recommending the level of GPMC oversight for each program.
4. Recommending program responsibilities for Lead Centers and approving the assignment of project responsibilities according to the Program Plan.
5. Recommending new programs to the Agency's PMC.
6. Developing, coordinating, and maintaining the PCA.

7. Approving Program Plans.
8. Assessing program performance against requirements and customer expectations.
9. Ensuring timely resolution of multiple program and project issues within the assigned Enterprise.
10. Serving as a member of the Agency's PMC and appropriate GPMCs.
11. Allocating budgets to programs.
12. Managing program formulation.
13. Ensuring that products and services meet customer requirements.
14. Identifying and developing interface with customers.

D. The NASA CFO/Comptroller is responsible for the following:

1. Reviewing results of the NAR and IAR with the Chief Engineer.
2. Concurring with and recommending changes to the PCC during program and project implementation that arise from economic and fiscal changes outside the control of the Agency.
3. Providing notification to the Administrator and EAA whenever the projected fiscal resource requirements exceed the baseline PCC or the DCC component of the baseline PCC as specified in the PCA.

E. The NASA Chief Engineer is responsible for the following:

1. Serving as the process owner for the PAPAC process, including development and maintenance of this document.
2. Providing ICEs for proposed new starts.
3. Providing for the IARs, NARs, and IAs.
4. Collecting, analyzing, and disseminating lessons learned/process knowledge related to this document.
5. Appointing NAR chairpersons for programs/projects under the oversight of the NASA PMC.

B.2 CENTER RESPONSIBILITIES

B.2.1 LEAD CENTER

A. The Lead Center Director is responsible for the following:

1. Serving as (or designating) chairperson of Lead Center PMC.
2. Supporting the EAA in program formulation.

3. Providing overall direction, control, and oversight of program implementation.
4. Appointing the program manager.
5. Approving the Program Plan with the EAA.
6. Assigning work to other Centers.
7. Integrating institutional resources with program needs.
8. Coordinating cross-Center activities.
9. Ensuring compliance to policy/standards.
10. Developing and maintaining program/project implementation policies and procedures, compliant with NPD 7120.4B, this document, and ISO 9000.

B.2.2 MARSHALL SPACE FLIGHT CENTER

A. The MSFC Center Director is responsible for the following:

1. Performing advanced concept studies in support of Agency and Enterprise Strategic Plans.
2. Supporting the Lead Center Director in program formulation.
3. Approving the Project Plan.
4. Appointing the Project Manager.
5. Implementing and overseeing the project.
6. Developing and maintaining program/project implementation policies and procedures, compliant with NPD 7120.4B, this document, and ISO 9000.
7. Serving as (or designating) chairperson of the Center PMC, consistent with the LCD responsibilities.

B.2.3 PROGRAM MANAGER

A. The Program Manager is responsible for the following:

1. Program planning, including recommendation of program objectives, requirements, implementation guidelines, budget and milestones, and preparation of Program Plans and supporting development of PCAs.
2. Developing, recommending, and advocating the program resources.
3. Allocating budget to projects.
4. Establishing support agreements.
5. Executing and overseeing the Program Plan.
6. Controlling of program changes.
7. Approving Project Plans and associated changes to these documents.

8. Establishing project performance metrics.
9. Integrating the planning and executing of individual projects on programs comprised of multiple, interdependent projects.
10. Reviewing and reporting program/project performance.
11. Complying with applicable Federal law, regulations, Executive orders, and Agency Directives.

B.2.4 PROJECT MANAGER

A. The Project Manager is responsible for the following:

1. Preparing and maintaining the Project Plan, specifications, schedules, and budgets.
2. Establishing support agreements.
3. Acquiring and utilizing participating contractors.
4. Executing the Project Plan.
5. Supporting the program management and integration.
6. Reporting project performance and status, including contracts.
7. Complying with applicable Federal law, regulations, Executive orders, and Agency Directives.

APPENDIX C – REFERENCED DOCUMENTS

Document Number	Document Title
AMO 2000	Advanced X-Ray Astrophysics Facility Operations Ground System Requirements
ANSI/ASQC Q9001-1994	American National Standard Quality Systems, Model for Quality Assurance in Design, Development, Productivity, Installation, and Servicing
FPD-OI-FD40.1	Macro Flow for Ground Systems Operations
FPD-OI-FD43.1	Ground System Operations
HOSC-EHS-205	Operations and Maintenance Life Cycle Definitions
HOSC-HUH-233	HOSC Users Handbook
HOSC-MCD-1200	HOSC Operations Configuration Document
HOSC-PLAN-009	HOSC Contingency Plan
HOSC-PLAN-119	HOSC Training Plan
HOSC-PLAN-635	HOSC Risk Management Plan
HOSC-PLAN-661	HOSC Project Quality Plan
HOSC-PROC-163	HOSC Certification Procedures
HOSC-PROC-180	HOSC Standard Operating Procedures
HOSC-PROC-187	HOSC Internal Operating Procedures
HOSC-RQMTS-2467	HOSC Security Requirements
IGSS 54500	International Ground System Specification
ISO 9000	ISO Quality Management and Quality Assurance Standards
MPD 1280.1F	Marshall Management Manual
MPG 1050.1B	Contract (Customer Agreement) Review
MSFC-HDBK-003	HOSC Facility Document
MSFC-PLAN-904	HOSC Functional Requirements and Implementation Plan
MSFC-PLAN-2929	Configuration Management Plan for the HOSC
MSFC-PLAN-2934	HOSC Emergency and Disaster Recovery Plan
MSFC-PLAN-3046	HOSC Project Data Management Plan
MSFC-RQMT-1440	Generic Requirements for the Enhanced HOSC System
MSFC-RQMT-2436	Enhanced Mission Communication System Level A Requirements
MSFC-RQMT-2467	HOSC Information Technology Security Requirements
MSFC-RQMT-2639	ISS Mission Computations
MSFC-SPEC-2123	PDSS Development Specification

MSFC-SPEC-3229	PPS Specification
MWI 1700.1	Payload Safety Readiness Review Board
NPD 1000.2	NASA Strategic Management Handbook
NPD 7120.4B	NASA Policy Directive (NPD) Program/Project Management
NPD 8730.3	NASA Quality Management System Policy
NPG 7120.5A	NASA Procedures and Guidelines (NPG) NASA Program and Project Management Processes and Requirements
NSTS/ISS 18798	Interpretations of NSTS/ISS Payload Safety Requirements
SSCN 537	Hazardous Commanding
SSP 50304	POIC Capabilities Document
SSP 54500	International Ground System Requirements
SW683-70256-1	Payload Planning System, System Specification

APPENDIX D – LIST OF ACRONYMS

ARC	Ames Research Center
ASI	Italian Space Agency
AXAF	Advanced X-Ray Astrophysics Facility
CA	Customer Agreement
C&DH	Command and Data Handling
CB	Control Board
CCB	Configuration Control Board
CDR	Critical Design Review
CEIT	CPS to EDR Interface Tool
CFO	Chief Financial Officer
CIC	Capital Investment Council
CIC	Crew Interface Console
CM	Configuration Management
CMDR	CM Delivery Review
COOP	Continuity of Operations Plan
COTS	Commercial Off-The-Shelf
CPAF	Cost Plus Award Fee
CPS	Consolidated Planning System
CR	Conference Room
CSA	Canadian Space Agency
CSOC	Consolidated Space Operations Contract
CSS	Command System Service
CWA	Conference Work Area
CWC	Collaborative Work Commitment
CXO	Chandra X-Ray Observatory
DADS	Data Acquisition and Distribution Services
DAE	Data Acquisition Extraction
DBCG	Database Coordination Group
DCC	Development Cost Commitment
DM	Data Management
DOLILU	Day of Launch I-loads Update
DRC	Data Reduction Center
DSRC	Data System Routing and Configuration
EA	Environmental Assessment

EAA	Enterprise Associate Administrator
ECR	Engineering Change Request
EDR	External Data Repository
EHS	Enhanced HOSC System
EIA	EXPRESS Integration Agreement
ESA	European Space Agency
ET	External Tank
ETO	Engineering and Technology Office
EVM	Earned Value Management
FAR	Federal Acquisition Regulation
FCA	Functional Configuration Audit
FDPA	Flight Dynamics Planning and Analysis
FEP	Front End Processor
FMEA	Failure Modes and Effects Analysis
FMECA	Failure Modes, Effects, Analysis, and Criticality Analysis
FPD	Flight Projects Directorate
FPIF	Fixed Price Incentive Fee
FRT	Flight Readiness Test
FTA	Fault Tree Analysis
GDS	Ground Data Services
GOAL	Ground Operations Application Language
GPMC	Governing Program Management Council
GRC	Glenn Research Center
GSD	Ground Systems Department
GSE	Ground Support Equipment
GSRD	Ground Support Requirements Document
HDS	HOSC Data Set
HMCG	HOSC Management Coordination Group
HOCG	HOSC Operations Coordination Group
HOSC	Huntsville Operations Support Center
HRR	HOSC Readiness Review
HST	Hubble Space Telescope
IA	Independent Assessment
IAR	Independent Annual Review
ICB	Integration Control Board
ICD	Interface Control Document

ICE	Independent Cost Estimate
IDD	Interface Design Description
ILC	Integrated Launch Checkout
IP	International Partners
IP&CL	Instrumentation Program and Command List
ISMAC	Integrated System Monitor and Control
ISO	International Standards Organization
ISS	International Space Station
ISSP	International Space Station Program
IST	Integrated Support Team
IT	Information Technology
IVoDS	Internet Voice Distribution System
IVT	Integrated Verification Test
JSC	Johnson Space Center
KSC	Kennedy Space Center
LCC	Life Cycle Cost
LCD	Lead Center Director
LIEF	Launch Information Exchange Facility
LMC	Lockheed Martin Corporation
LSSP	Launch Site Support Plan
MAO	Management and Assessment Office
MBF	Mission Build Facility
MET	Mission Elapsed Time
MET	Meteorological
MIC	Management Integration and Coordination
MIDDS	Meteorological Interactive Data Display System
MPD	MSFC Policy Directive
MPS	Main Propellant System
MRB	Management Review Board
MSFC	Marshall Space Flight Center
MSFC TSC	MSFC Telescience Support Center
MSS	Mission Support Services
NAR	Non-Advocate Review
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency
NOA	New Obligation Authority

NPD	NASA Policy Directive
NPG	NASA Procedures and Guidelines
NRT	Near Real-Time
O&M	Operations and Maintenance
OCC	Operations Control Center
OFLS	Off-line System
OMRS	Operations and Maintenance Requirements Specification
ONLS	On-line System
OPS	Operations
OPSIM	Operations Simulator
ORR	Operations Readiness Review
OSTP	Onboard Short Term Plan
P/L	Payload
PAPAC	Produce Aerospace Products and Capabilities
PC	Personal Computer
PC-GOAL	PC Ground Operations Application Language
PCA	Program Commitment Agreement
PCC	Payload Control Center
PCC	Payload Command Controller
PCTS	Payload Checkout and Test System
PDL	Payload Data Library
PDR	Preliminary Design Review
PDSS	Payload Data Services Systems
PEB	Performance Evaluation Board
PG	Product Generation
PI	Principal Investigator
PMC	Program Management Council
POCC	Payload Operations Control Center
POIC	Payload Operations Integration Center
POP	Program Operating Plan
POP	Period of Performance
PPM	Program/Project Management
PPS	Payload Planning System
PRA	Probabilistic Risk Assessment
PSIV	Payload Software Integration and Verification
PTC	Payload Training Center

PVP	Payload Verification Plan
REM	Resource Envelope Management
RRB	Risk Review Board
RSA	Russian Space Agency
SAC	Shuttle Action Center
SCDS	Space Communications and Data Systems
SDS	Shuttle Data Stream
SESR	Shuttle Engineering Support Room
SEST	Shuttle Engineering Support Team
SIT	Shuttle Interface Test
SL	Spacelab
SLOC	Software Lines of Code
SMAC	System Monitor and Control
SOMO	Space Operations Management Office
SPO	Shuttle Projects Office
SRB	Solid Rocket Booster
SRDS	Support Requirements Data Set
SRR	System Requirements Review
SSCC	Space Station Control Center
SSME	Space Shuttle Main Engine
SSP	Space Station Program
STP	Short Term Plan
STS	Space Transportation System
TAS	Test and Simulation
TBD	To Be Determined
TGHR	Time-critical Ground Handling Requirements
TOPS	Terrestrial Operations Support
TPM	Technical Performance Measures
TPS	Telemetry Processing Service
TR	Training Room
TReK	Telescience Resource Kit
TSC	Telescience Support Center
TTA	Technical Task Agreement
UF	Utilization Flight
UMS	Utilization Mission Support
UOF	User Operations Facilities

URC	User Requirements Collection
USGS	United States Ground Segment
USOC	United States Operations Center
USOS	United States Orbital Segment
V&V	Validation and Verification
VMDB	Vehicle Master Database
WBS	Work Breakdown Structure